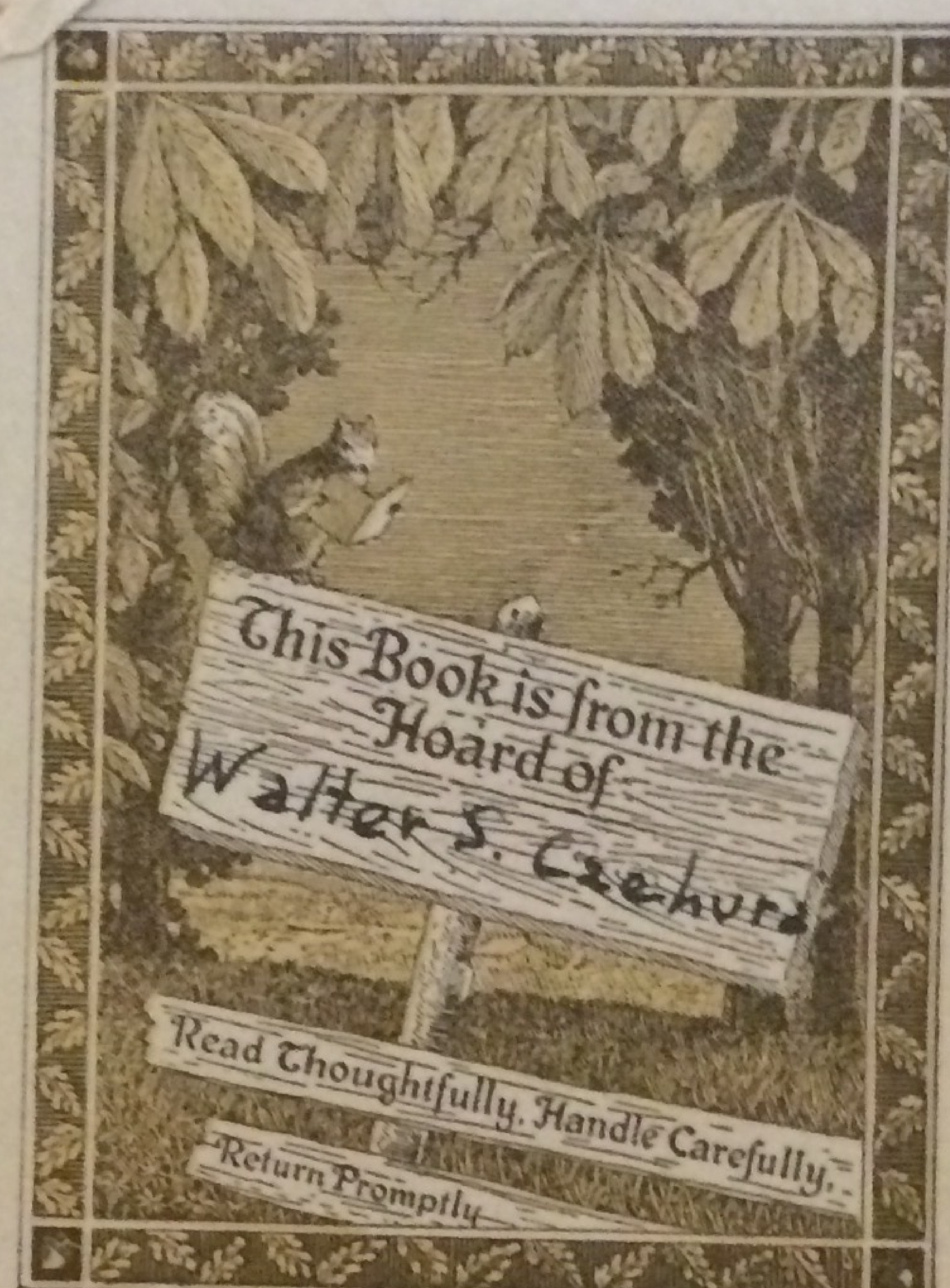
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EXPERIMENTAL BASIS
FOR
NEUROTIC BEHAVIOR

Origin and Development of Artificially Produced
Disturbances of Behavior in Dogs

Nick in camera, 1938, listening to tone which produced the conflict in 1933. Note the "anxious" facies, pulling on leash, tension in forelegs, sexual erection.

EXPERIMENTAL BASIS FOR NEUROTIC BEHAVIOR

Origin and Development of Artificially Produced Disturbances of Behavior in Dogs

BY

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DEDICATION

DEAR HAMILTON AND OLGA,

To the many happy days when we have played on your lawn, eaten your bread and salt and drunk your mead—in a changing world to the unchanging symbols of cheer and friendships.

From Horsley, Moosenka, Andy and Perky

FOREWORD

THIS MONOGRAPH represents the studies of a 12 year period in the Pavlovian Laboratory at the Phipps Psychiatric Clinic on the nervous disturbances of dogs. When these psychopathologic reactions were first observed in 1931, it was thought unnecessary to publish an account of the experiments, especially as the early disturbances arose accidentally and the symptoms did not differ essentially from those reported previously by Pavlov. But when the animals were kept for longer and longer periods and more detailed studies accumulated, both as a result of planned experiments and of observations over the life-span of the dogs, new and important relationships between the various pathological symptoms appeared, as well as data on the first subtle and hidden (except to special methods of examination) phenomena of nervous imbalance. An advantage of the prolonged life study of the neurotic animal is evident in Nick, the present veteran of the laboratory, who has now been under observation for 12 years and shown nervous imbalance for a decade. Further justification for the present work is the addition made to Pavlov's studies through the measurements and interrelationships of several autonomic malfunctions, particularly the sexual phenomena. These considerations have led me to organize the material of the laboratory relating to psychopathology.

In the laboratory animal, in contrast to present knowledge concerning the human subject, the spread of the nervous imbalance can be detected before it is overtly expressed, traced from its origin step by step, and followed during its extension to the various physiological systems. Furthermore the prolonged study provides opportunity for investigation of social and personal relationships.

Another delay in the publication of these investigations arose from a change in my point of view. Originally I had felt that more research on the physiology of the conditional reflexes was in order before a successful discussion of the pathology could be completed. Some of this has already been done here, e.g., such as 1) the exponential relationship between amounts of conditional reflex and unconditional stimulus, and 2) the change in heart rate accompanying excitatory and inhibitory conditional reflexes. But though important gaps still exist in the normal physiology, I have become more aware of the impossibility of adequately describing normal and abnormal behavior except in the terms and elements of behavior, notwithstanding the important biochemical, physical, and physiological correlations that should be made at every step.

A pressing need for the study of nervous imbalance is seen in the present and periodically recurring chaotic relations existing among separate nations and peo-

ples. Although the basic principles of conflict are hardly different from those that have existed for centuries, the means of destruction and organization have been magnified to an alarming extent even in the past 20 years. Moreover emotional balance does not keep pace, either ontogenetically or phylogenetically, with the accumulations of knowledge and the attainments of science. It is a sad but obvious commentary that, allowing for individual exceptions, the civilized man has no advantage over the primitive, nor even the cultured and educated over the ignorant, nor the leader over the follower, in adopting means of living together in reasonable harmony and security compatible with our advanced scientific and industrial development. The ignorant and the learned act almost identically when emotionally aroused—whether by avarice, fear, or love. Thus in the face of an emotional crisis, individual or national, we cannot look to any class or race for salvation; though there are many leaders and exhorters, it is only the exceptional man who may provide a solution. Even among our own group of scientific workers, who may consider themselves purified in the cauldron of disciplined thinking, we see now the sad realization of Pavlov's prophecy in 1936—that the same body of scientists gathered together and united in a common effort (at the International Physiological Congress, Moscow, 1935) would in the event of war be seeking as vigorously to destroy one another. War, the parasitic monster feeding on human society, depends not only upon technical economic questions, but upon a specific knowledge of the laws of imbalance, and as no nation can rely either upon immunity or upon always being the victor, it behooves the strong as well as the weak to inquire into these laws.

"In America our most essential problem now that the frontier has gone is to learn to live together" (Alan Gregg). The same applies to the more complex problem of living together internationally. In such a periodically recurring chaotic world state of affairs any approach to the question of emotional imbalance is important. Though this monograph may have only a remote and at present indirect relation to international problems of upheaval, a study of the emotional reactions in the laboratory offers some knowledge, and may open one door for the control of the destructive tendencies that make adjustments difficult, both individually and internationally.

This book begins with the citation of some remarkable examples of the successes of an objective psychopathology. Lest some of the statements appear overzealous, let me interpolate not a recantation but the admission of the fragmentary nature of much of the material, and its need for further amplification and verification in the clinic. In order to study animals over their life span under many and varying circumstances, it is necessary to restrict the number to only a few individuals. Notwithstanding the fact that Nick, for example, has been carefully observed for 12 years (the average life time of a dog and almost one-third the whole productive laboratory career of a research worker) with upwards of 15,000 conditional

reflexes separately recorded, he is an example of what happens in only one type of dog; for individual variations are even more striking than the similarities, as will be seen from a comparison of Nick, Peter and Fritz. But in spite of the immensity and complexity of the problem before us, by the piecing together of many controlled observations from the laboratory and from life we may step by step arrive on firm ground in the field of psychopathology.

Though certain facts at the basis of disturbed behavior (such as the development of the anxiety-like state from the original focus over a period of years to involve chronically many physiological systems, the reciprocal relations between conflict and pathological sexual manifestations) have been demonstrated for the first time experimentally in this laboratory and are presented in this monograph—this advance of our knowledge has not yet led me into the temptation of formulating a general system: the awareness of the complexity of the problem and extensiveness of the field has kept me more on a descriptive basis and disposed me to take but a few steps at a time. Though possessing certain advantages in clearness of presentation, conceptual interest, and sometimes the stimulus for further work—the desire to arrive too early at a generalization and systematization often means the end of successful experimentation. To those readers who look for such a systematization, I reply that I am willing to await the time when our knowledge is more complete.

The treatment of my own material is biased to the extent that I have made no attempt to coordinate or to review the work of others. Furthermore I have presented my own work in its chronological development, describing Pavlov's methods and concepts historically rather than critically. Emphasis has been laid on the new facts repeatedly observed, the interrelationship of functions, the early detection and measures of nervous imbalance and the analysis of the underlying factors.

After the historical development of Pavlov's concepts (Ch. I) and a general description of methods (Ch. II), the step by step loss of nervous balance is described beginning with natural emotional shocks (Ch. III) and extending through the various categories of laboratory procedure (Ch. IV). The detailed life history of three dogs subjected to the same difficult routine (Ch. V) precedes the categorical enumeration and interpretation of the symptoms according to physiological systems (Ch. VI) and the results of therapy (Ch. VII). The emphasis on the existence of functional types and the general scheme of detecting the susceptible ones by the careful measurement of their reactions to controlled stresses is given in Ch. VIII, and the concluding chapter presents trial analyses of the states of imbalance described in these studies. Here I have been fortunate in soliciting the interest of three such authoritative psychiatrists as Drs. Ischlondsky, Saul and Leighton to make an evaluation and interpretation of the symptomatology of Nick (in Chaper IX).

This laboratory was started in 1929 on the initiative of Dr. Adolf Meyer. The

first experiments were done in collaboration with Dr. Wolff. He, Dr. Loucks and Dr. Brogden have, in addition to their researches here, also made valuable technical contributions.

The colleagues whose efforts in this laboratory have contributed either to these or related experiments are, in chronological order: Drs. Harold G. Wolff, Roger B. Loucks, Oskar Diethelm, Wendell Muncie, J. S. Light, S. Katzenelbogen, Glen Finch, W. J. Brogden, H. Löwenbach, E. B. Alpern, N. Finkelstein, W. C. Hoffmann, Victor Rosen, M. B. Macht, S. Dworkin, M. Freile Cordovez. The charts have been made and the MS prepared by Rebecca E. Bromiley. To Miss Ruth Potter I am grateful for the editorial corrections. Dr. John C. Whitehorn has generously devoted much time to the reading of the material and given me valuable counsel; Dr. Arnold Rich has contributed the experiments with the gastric secretion and he and Drs. H. M. Thomas, George Thorn, Emmett Holt and H. S. Liddell have aided me with suggestions. To all these friends I am deeply grateful.

W. H. G.

Johns Hopkins University
Baltimore
January, 1944

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ABBREVIATIONS

C = camera
cs = conditional (conditioned)* stimulus
csi = conditional (conditioned) stimuli
cr = conditional (conditioned) reflex or response
crs = conditional (conditioned) reflexes
UR = unconditional (unconditioned) reflex
URs = unconditional (unconditioned) reflexes
US = unconditional (unconditioned) stimulus
USi = unconditional (unconditioned) stimuli

By using small letters for the conditional response and stimulus and capitals the unconditional reflex and stimulus, the meaning is evident at a glance with reference to the logical derivation of the terms—so often confusing to the reader.

Signals (conditional stimuli).

M60 = metronome of 60 beats per minute.
L60 = light of 60 flashes per minute.
T1000 = tone of 1000 cycles per second, etc.
Bu = sound of air bubbling through water.
Be = sound of door bell.

The 24 hour system is used in this monograph, e.g., 1 p.m. written 13:00, 2 p 14:00, etc.

The secretory reflexes are expressed in our arbitrary scale divisions where 1 (mm = 0.00167 cc. (parotid) saliva from one gland.

HS = Harry Schmidt, technician in the Pavlovian Laboratory from 193 1944, who worked most with Nick, bringing him down from the p dock, putting him in the camera and doing the daily experiments.

RBL = R. B. Loucks, who conducted experiments with Nick, Peter and F 1931 to 1935.

AE = Albert Erdman, technician during 1940-42, but never worked w Nick.

WHG = W. H. Gantt, though with Nick in laboratory, less closely associ with him in the early experiments than HS; with Nick on the fa

* Conditional and not conditioned is the term used by Pavlov, but since this was first translated English from German and not directly from Russian it is traditionally and incorrectly written condi

I. THE EVIDENCE FOR OBJECTIVE PSYCHOPATHOLOGY; HISTORICAL REVIEW

PSYCHOBIOLOGY and perhaps psychopathology stand on the threshold of a new era. Hardly a science until now, not only can psychobiology at present be recorded in significant objective terms but also some of its elemental data can be formulated as exact mathematical relationships.

As evidence of the recent scientific progress in bringing order and exactness into this field, I shall mention the following:

Pavlov began with the demonstration that the salivary secretion could be used as a qualitative register of "psychical" phenomena (the conditional reflex). This fact alone was an epochal discovery. Later Lyman and Kupalov (*68*) showed that the relation between conditional reflex and conditional stimulus was probably of a logarithmic character, and recently I have adduced evidence that the conditional reflex to a given unconditional stimulus can be expressed in a formula just as the corresponding unconditional reflex or the relationship between two events in the physical world can be.[1] Thus the formula for the unconditional reflex (parotid secretion) is UR $= a + bQ$, i.e., a linear relationship, while for the conditional reflex the formula is exponential, viz., cr $= a + b\,(1 - e^{-cQ})$ where a, b, c are constants for a given dog, UR and cr the unconditional reflex and conditional reflex response in units of secretion, Q the quantity of food by which the conditional signal is habitually followed, and e the base of natural logarithms (fig. 1).

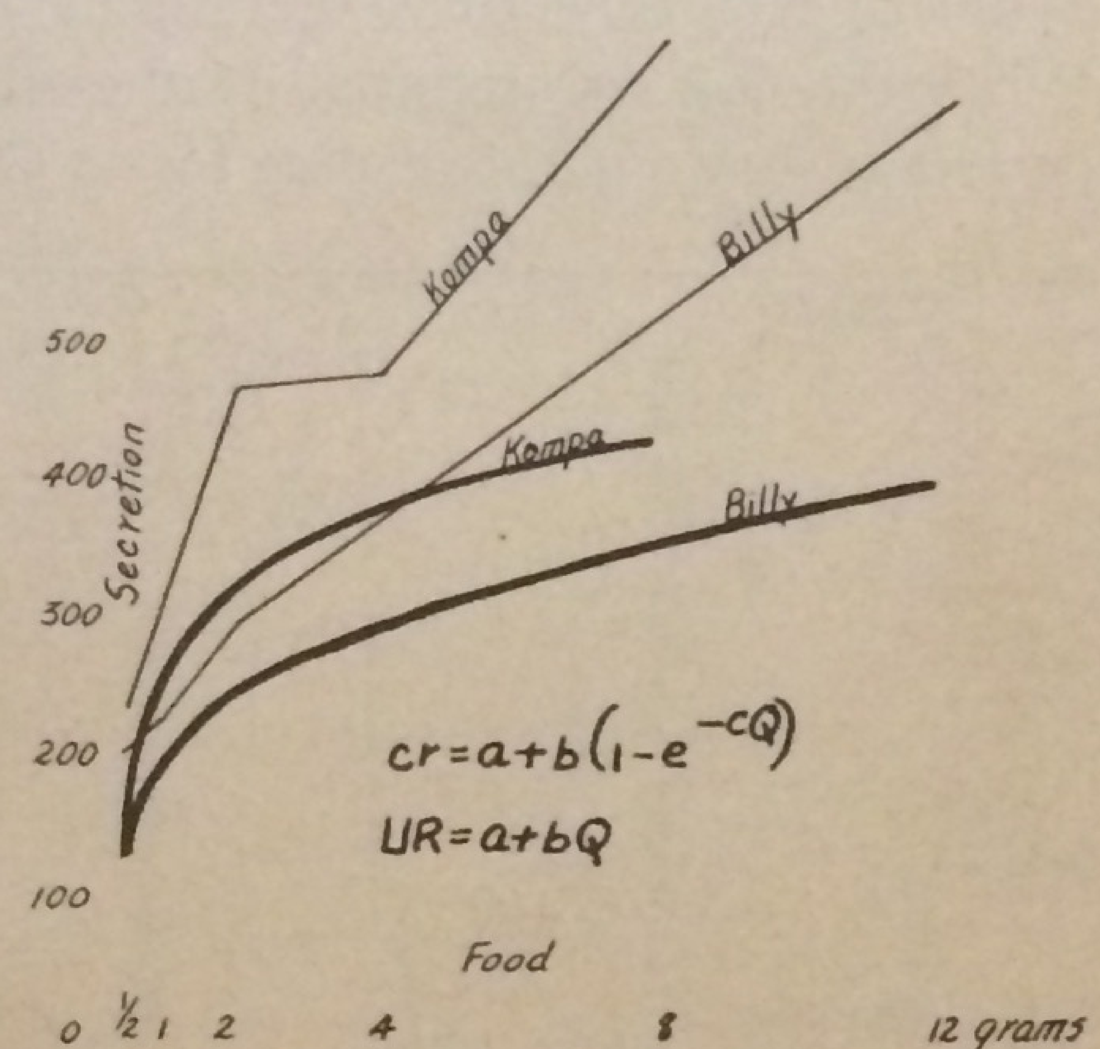


FIG. 1. Relation between stimulus (food) and cr (secretion) and stimulus and UR. Light lines = UR, heavy lines = cr.

Extending the study of the salivary conditional reflex to include allied somatic phenomena, it has been shown in this laboratory that accompanying the nervous

[1] A century ago psychology made a beginning as an exact science with the enunciation of the Weber-Fechner law. However, no great advances occurred along these lines. Here is not the place to discuss the pros and cons of the old controversy as to whether a quantitative or a qualitative description in psychobiology is desirable, or to evaluate the various psychological approaches, as my purpose now is to show briefly what has been accomplished along several lines from a special type of study.

excitation of a bell signaling food (and independent of any effect of the bell pe-
se or of the muscular movements) there is a definite and *specific* change in the
cardiac and respiratory rates, that the cardiac rate is strictly proportionate to the
amount of food the bell has been accustomed to represent, and furthermore the
if the bell represents inhibition instead of excitation the heart rate is different but
nevertheless specific.

Psychopathology benefits from the exactness of the relations measurable by the
above objective methods. Below are examples of pathologic changes in the in-
tensity of the conditional reflexes as recorded in the motor, salivary and respira-
tory, as well as in the cardiac crs.

A dog, Neptune, had been giving perfect differentiation between T256 (+)
and T384 (—) from 14 February until 22 June. On this day he was placed upon
a diet deficient in B_6 and pantothenic acid. On the third day after this deficien-
the dog began to show impaired differentiation between the two Tones wh-
gradually became worse so that there was little or no differentiation after 10 Ju-
When the dog was returned to the adequate diet the differentiation was agai-
perfect as shown in the reading for 21 October in fig. 2 (experiments with Dr. M.
Wintrobe).

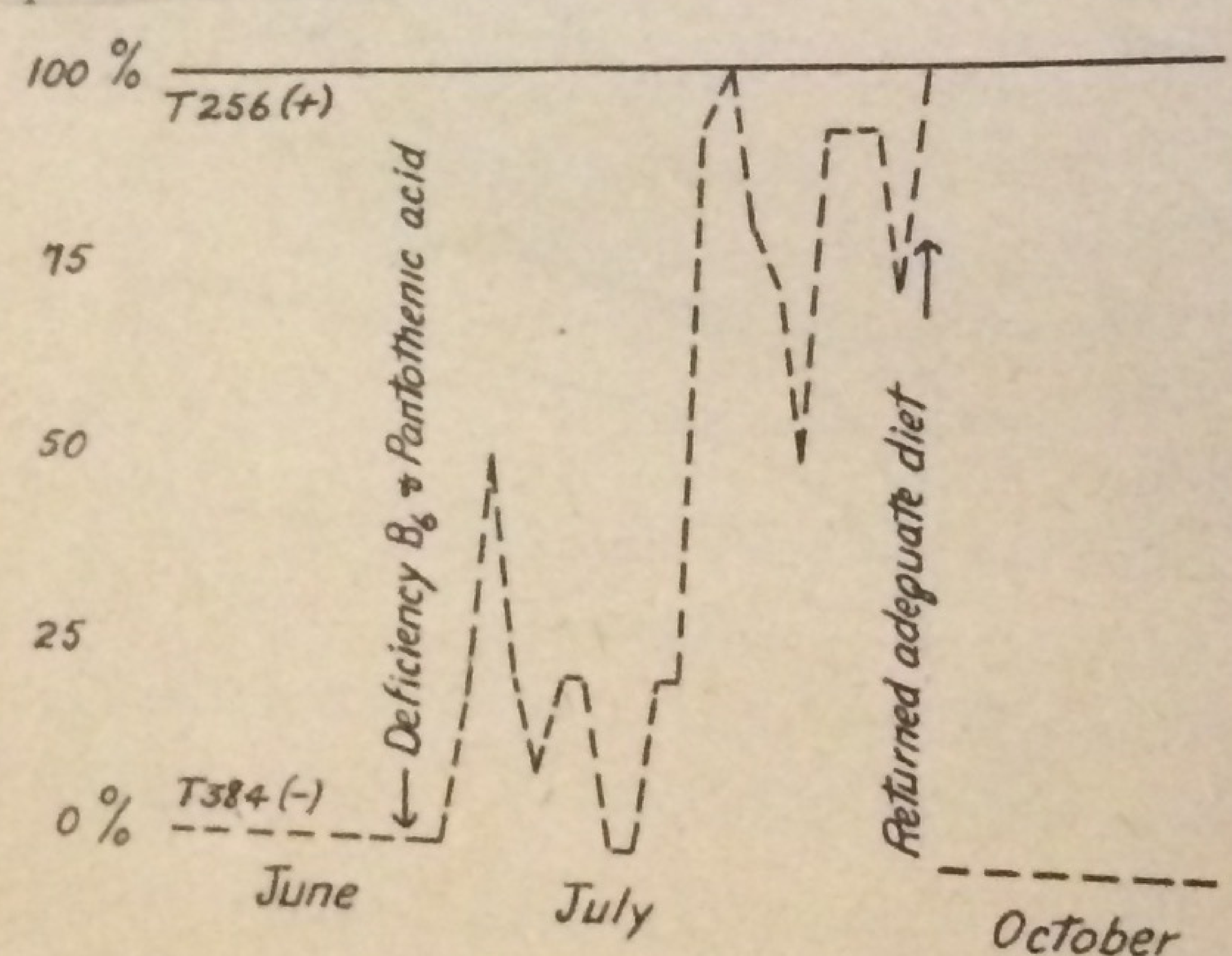


FIG. 2. Impairment differentiation caused by vitamin deficient diet. Ordinates = percent of positive conditioned motor responses. T256 (solid line) = 100% and T384 (dotted line) = 0 represents perfect differentiation.

In another dog (Nick) chao-
relationships arose as a result of
a psychopathological state, so th-
all the salivary conditional re-
sponses were reduced to zero, an-
the chaotic relationships were al-
expressed in the heart rates, a-
will be shown later (figs. 14, 3-

Furthermore in experimen-
with metrazol used as in shoc-
therapy (with Dr. Victor Rose-
both the salivary and the mot-
conditional responses were re-
duced and the inhibitory ones in-
creased for a period of six month-
in two dogs long after there was not the slightest change in the ordinary behavi-
although this was carefully observed (figs. 3a and 3b).

Thus by a specific quantitative knowledge of the normal laws we are at once
able to detect the pathological, earlier than by any other means of ordinary ob-
servation howsoever carefully made, before the disturbance is reflected in a gener-
disorganization, and moreover to say exactly when and how the psychopathologi-

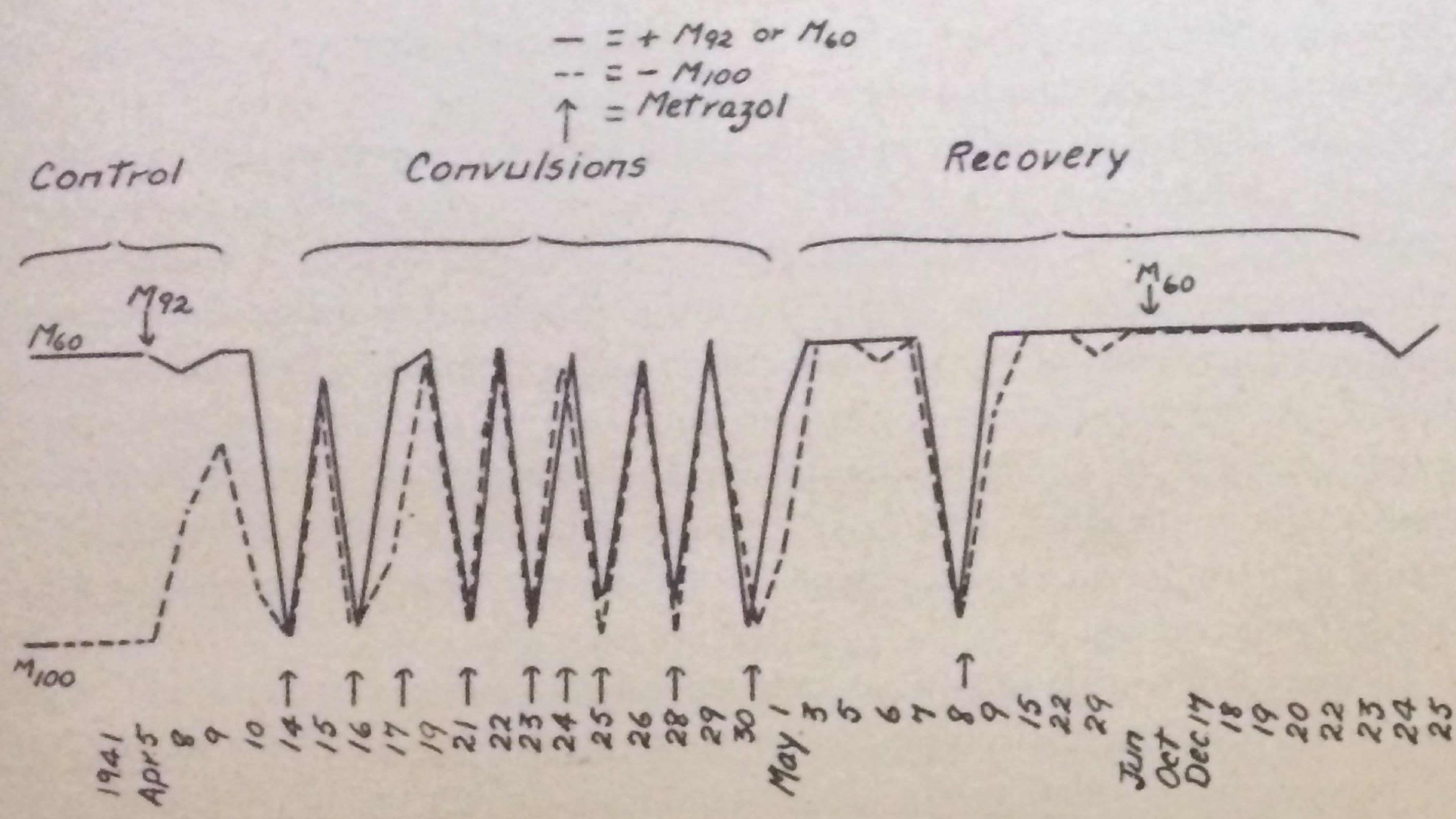


FIG. 3a. Effect of metrazol on motor cr's in stable dog (Connie).

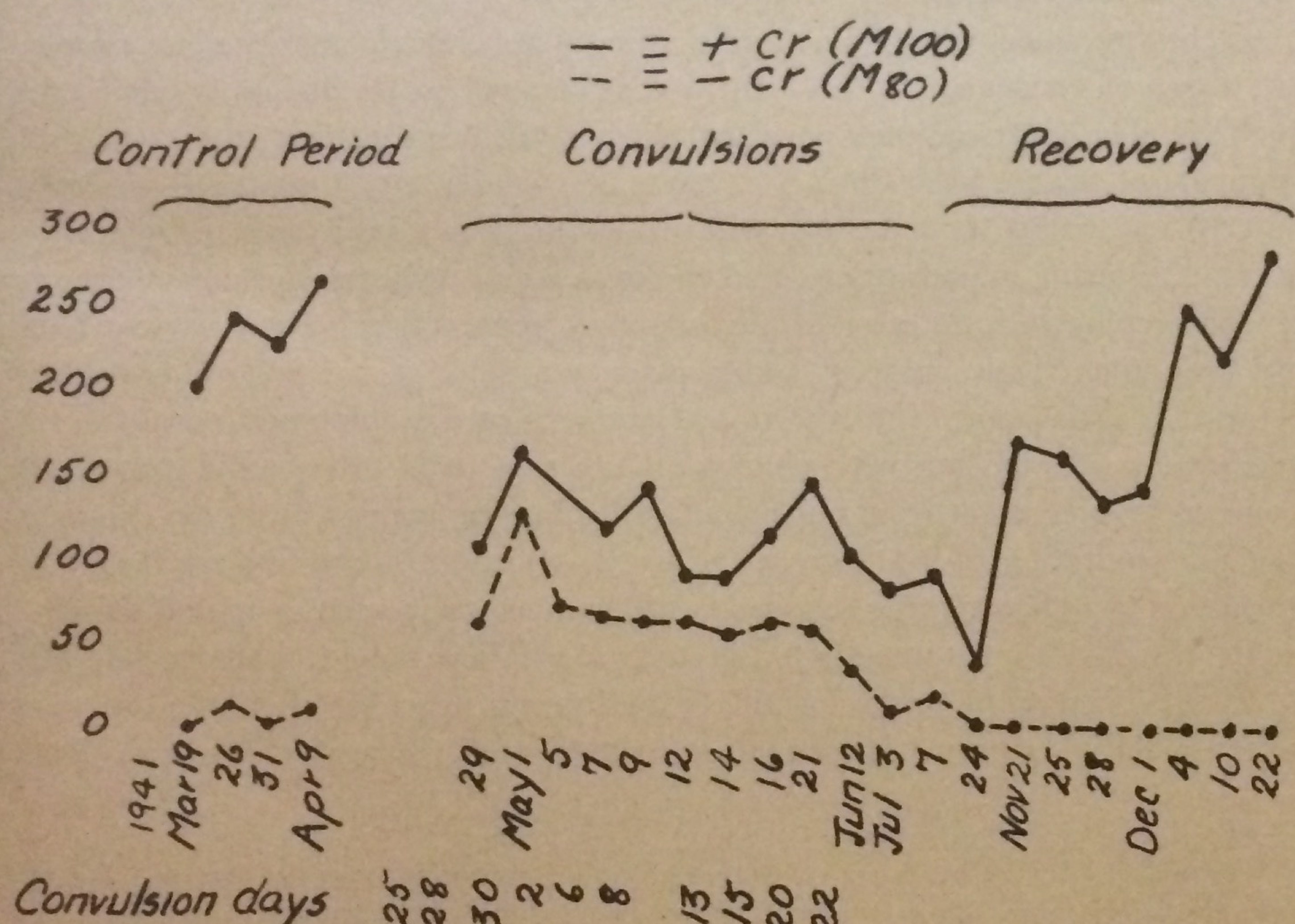


FIG. 3b. Effect of metrazol on salivary cr's in stable dog (Sechs).

phenomena began. Although this goal has been partly attained in the dog, its application to the human has yet to be made.

We can point with exaltation to these landmarks of objective progress, but a word of sobering caution is in order. The advance has reached a terminus along some lines, e.g., in the mathematical statement of the formula for the conditional reflex, but the progress has hardly begun in closely allied fields. The uneven development makes difficult the correlation and proper use of psychobiological data. Even the use of a formula derived under the strict conditions of the laboratory is generally not applicable to psychobiological phenomena in daily life because many factors eliminated in the laboratory are active components of the life situation. Furthermore an equation is unable to express relationships between more than a few variables.

In spite of the inadequacy of a mathematical statement to express a total situation of any kind, especially a psychobiological one, the above citations are evidence of psychosomatic relationships obeying laws as definite as physiological phenomena.[2]

Though these examples show where we stand now, it is not without profit to review the first hard steps of the journey.

Lightning and flood, famine and pestilence are thought by primitive people to be acts of vengeance from wrathful gods or demons, by analogy to one's own feelings. The most complex nervous behavior was not subjected to the ordinary methods of science even during centuries of scientific investigation. It was considered as arising spontaneously by analogy to man's subjective feelings. But science has made inroads upon all of the conceptions regarding inanimate nature; it is in keeping with the spirit of the times that we modify this point of view. Now we look upon these events as taking place in a more or less orderly sequence.[3] Thus it is in harmony with the rest of our present day thinking to consider the phenomena of our own psychobiological life as a chain of scientific events; we come to divorce them from our primitive feelings of analogy as we have done in the personification of Nature. In the words of Adolf Meyer we are beginning to suspect that "everything concerning the human is accessible to natural science."

Pavlov gave a great impetus to the study of psychopathology when he described in 1921 a method of producing the "experimental neurosis." Like the discovery of the malarial treatment of general paresis by two Russians in 1888—forty years

[2] For a more general viewpoint see Gantt (31).

[3] In spite of this there has been a swing away from the former rigid concept of cause and effect to a more plastic one involving the elements of chance. An excellent critical evaluation characterized by a remarkably clear and analytical insight of the role of cause and effect vs. chance in determining human events was given by Tolstoi in "War and Peace." A more recent article emphasizing the physical basis for chance reactions is that of Langmuir (69). See also, Smuts: Holism and Evolution. New York, 1926.

before its general use—and the early reports of the use of sulphanilamide, these experiments of Pavlov attracted no attention until recently when they have been extended by a good many workers in this country to various animals, from the rat to the primate.

Since the first researches on the experimental animal neuroses originated in Pavlov's laboratory and most of the subsequent work has been based upon his methods, this brief review concerns chiefly the evolution of his investigations and concepts.

No attempt is made in this monograph to list all of the pertinent later work on experimental neuroses[4] nor of the different concepts involved in the whole question of psychosomatic relationships. As I have previously given a critical evaluation of Pavlov (*89*) I shall confine myself in this monograph to the particular historical development of the methods and concepts that underlie the technique (used by Pavlov) which has been made the basis of nearly all the research on the experimental neuroses. To avoid a reference of the method to the underlying concepts would result, it seems to me, in camouflage and confusion. Later in the discussion, different points of view will be given. A clear statement of the Pavlovian concepts does not exclude clinical methods of investigation which make use of, first, additional information derived by probing into the individual's subjective life, through the aid of the extraordinary development distinguishing man from lower animals—the function of speech; nor second, the application of the concept of total integrated action wherever the behavior of the total personality[5] cannot be profitably analyzed into simpler components.

In spite of Pavlov's zealous contentions, it is not my desire to suggest for the Pavlovian technic an exclusive monopoly of objective methodology. A technic is useful which can be universally applied, and varies minimally from observer to observer. Besides being objective the system should deal with *significant* items. The conditional reflex method while neither infallible nor the only objective method, possesses both these characteristics (objectivity and significance) in a high degree. But objectivity is a relative term—any method used for psychobiological phenomena by the subjective human being must carry certain subjective fallacies, as well as errors inherent in the instruments, both human and mechanical. Even though we deal with as imperturbable forces as the passage of light through

[4] An extensive review and bibliography has been written by Masserman (*83*).

[5] From Plato to Adolf Meyer the total organism has received due theoretical recognition: thus "Good physicians apply their treatment to the whole body and attempt to heal the sick part or organ by treating the whole individual" (Plato in Charmides). But progress depends upon not only a balanced perspective and an evaluation of all the significant items and their interactions in the total situation and the organized unit as a whole, but also specific and analytical research directed toward special mechanisms or reactions; witness, e.g., the importance of the discoveries of insulin, of vitamins, and of the brain as the seat of the intellect.

space, an improvement of the instruments reveals the bending of the light rays by gravitation and led to the theory of relativity. An improvement of instruments has also been responsible for detecting nervous breakdown by changes in some conditional reflexes when others failed to register a change; see in Chapter III, e.g., the superiority of the cardiac conditional reflex over the motor crs as an index of imbalance.

In the field of literature this principle—dependence of knowledge on the instrument—has been recognized recently by Dos Passos (*17*) in a sociological novel where he attempts to describe the changing human instrument of observation in a series of interpolated chapters entitled "The Camera Eye." Although necessarily highly subjective, the pattern of this unusual novel is a paradigm for both the sociologist and the biographer. Moreover in science there would be much less confusion and fewer irreconcilable theories if greater attention were given to the conditions, methods and instruments (particularly the human) of observation.

An important step leading to the Pavlovian conception of animal neuroses as a disturbance of conditional reflex activity was that taken by Descartes[6] 300 years ago when he gave us the idea of reflex. He considered the animal as a machine which reacted to an external stimulus. The connection between the stimulus and the responding organ is made in higher animals by means of a nervous path. This concept of reflex has been used in physiology for more than three centuries, represented in our time by Sherrington's researches on the lower reflexes, and Magnus and de Kleijn's work on such complicated reactions as walking and the maintenance of balance in reference to gravity, showing they are chains of reflexes. An early application of the concept to the cortical functions was made by Sechenov, the father of Russian physiology and Pavlov's forerunner in his book "Reflexes of the Brain" published in 1863.

Pavlov established the idea of the *conditional* or individually acquired reflexes—variable, fluctuating, appearing, disappearing, symbolizing, substituting reactions, whence a delicate equilibrium is maintained in a system surrounded by a changing environment where the system is itself perpetually changing. The cerebral cortex in the higher animals is the chief organ of these plastic and delicate adjustments, keeping the organism in equilibrium with its environment.

The adjustment is made, partly at least, through the mechanism of the conditional reflexes. A conditional reflex can be formed between any change in the environment and an already existent activity of the animal. For this it is necessary that the change in the external or the internal milieu of the animal occur once or more in a definite time relation to some previously existing activity, frequently an inborn reflex. A conditional reflex is formed by changing the environ-

[6] The fact that Descartes failed to solve other fundamental biological problems and even made gross errors does not nullify his great contributions to the progress of physiology and science.

ment, e.g., ringing a bell or flashing a light, and following this by an unconditional stimulus, as food or an electric shock. The bell comes to produce a reaction similar to that produced by the food (or the shock); it is now a symbol or signal of feeding, and substitution has occurred. Accompanying the conditional reflex thus formed we say there is present in the nervous system the process of excitation.

In order to maintain and preserve its equilibrium to the fluctuating environment, the cerebral cortex must not only be capable of *synthesis*, but it must differentiate between other changes in the surroundings which have no relation to an inborn activity of biological importance for the animal such as the acquisition of food. The animal must decide between right and wrong, i.e., what corresponds to reality and what does not. Thus false signalization is avoided. This latter process of selection is what Pavlov calls *analysis*.

There undoubtedly exists a reciprocal action between the cortex and other parts of the nervous system and also the whole organism, and all these reciprocities play a part in the psychical life of the human.

The conditional reflexes often become more powerful than the unconditional upon which they are based. Even with the artificial stimuli that we use in dogs we have found that the 60 second secretion to the signal (a bell) for food may be twice as large as the secretion to the actual eating of the food, or the change in heart rate to this signal (cs) as great as the heart rate to the eating of the food (UR). The conditional reflexes under constant conditions are as precise and regular as the unconditional measured by the same method (fig. 4). But this does not mean that they are always the same under constant external circumstances. They may change, as I have shown, with the vacillating internal states of the animal (36). Another of their characteristics is their variability with the individual, the evidence of which will be given in a later chapter.

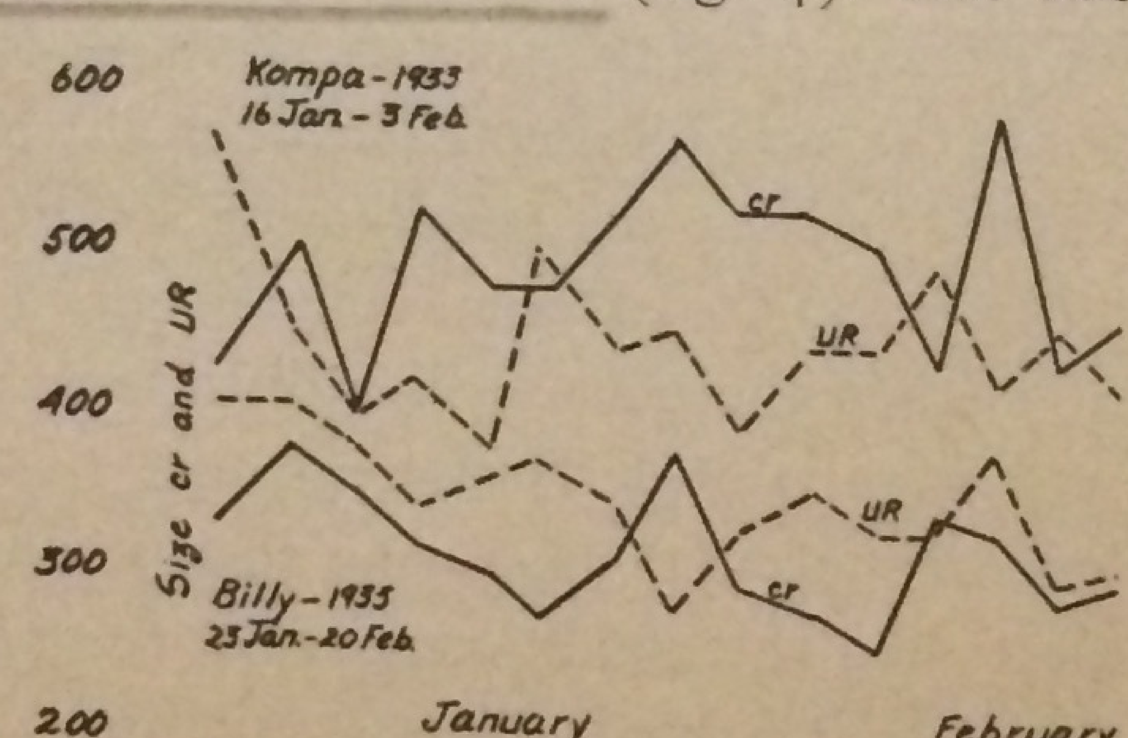


FIG. 4. Comparison of daily variations of salivary cr and UR in two dogs. Solid line = cr; dotted line = UR.

The cortex[7] preserves the equilibrium with a varying environment by means of analysis and synthesis, by choosing from among the mass of stimuli which fall upon it every moment those of biological importance, and by making a connection between any one of these stimuli and some inborn activity or some other acquired activity. The lower, segmental, generic reflexes are limited and fixed—they con-

[7] Recent facts tend toward a less rigid concept of the role of the cortex than was ascribed to it by Pavlov; e.g., the experiments of Zeliony in Pavlov's own laboratory, of Bard, Bromiley (4), Culler, Finch, Shurrager, et al (55).

stitute the *sine qua non* of existence for that species. But the cortex is contin creating and destroying connections during the life of the individual. We bring about and witness the whole panorama of these changes as we can no with the lower reflexes. This choosing between stimuli, reacting to some failing to react to others is accompanied by two opposed but in many ways sim cortical "processes"—excitation and inhibition; inhibition as well as excitati not a neutral but an active process.

The neurosis was considered by Pavlov a disturbance of the balance betwe system and its environment, whose equilibrium[8] was preserved through mechanism of the conditional reflex; by virtue of its ability to change, this rela in a changing environment or changing organism is preserved. Thus it is not the relatively non-fluctuating unconditional reflex. The UR must sustain a equilibrium characteristic of the species—it is the foundation upon which others are built. The differences of experience in each individual are registered those plastic reactions known as habits, reaction patterns, psychobiological reacti and conditional reflexes.

In the dog Pavlov thought that a "neurosis" results from a collision, in ti or space, of the processes of excitation and inhibition (see Ch. IV).

The pathologic disturbances may be very slight, lasting only a few minutes, they may continue for weeks, months, or years. Examples of both types will described subsequently. The most transitory form of disturbance is caused by ing too close together in time (collision in time) a positive and a negative stimul or by repeating the positive stimulus or one very similar to it without support it by the unconditional (collision in space). The disturbance in equilibrium m extend only to the neighboring conditional reflexes, but if it is serious it will reflected in the external behavior of the animal.

If then the neurosis is a disturbance in balance between a fluctuating organis and a variable environment, and the conditional reflex is one method of bo maintaining and measuring that balance, a disturbance in the balance may be flected in the conditional reflex record. This is a fact as well as a concept; em pirically it is known that disturbances of conditional reflex activity in animals often accompanied by marked observable changes in external behavior as well by certain undeniable emotional evidences, such as deviations in the respirati and circulation as will be seen later in the discussion. Conversely, variations intensity of the conditional reflexes and the balance between excitatory and hibitory conditional reflexes may be considered as indicative of an unbalanc state of the nervous system. Evidence of this appears in subsequent pages.

Experimental neurosis is the term first applied by Pavlov to the patholog

[8] The analogy of physical equilibrium probably is unhappily chosen, as it implies a static rather th a dynamic relationship.

behavior observed in his animals by this artificial conflict which he set up between "excitation" and "inhibition." The conditions of his animals varied so widely that it would be difficult to identify them with the clinical description bearing the same name. Indeed there is so much to be said for a revision of the clinical terms and the substitution of a more comprehensive and much less rigid one such as that exemplified by Meyer's "ergasiology" than to tie up to an already outworn and shaky structure by the use of identifying terms giving a false sense of security. Notwithstanding the simplicity of Pavlov's phrase "experimental neurosis," I would subscribe to a less rigid concept than that term signifies by the substitution of a more general term, *behavior disorder*, thus avoiding unjustifiable identification with a clinical condition of the same name.[9]

Later Pavlov himself spoke of these conditions as "pathological disturbances resulting from functional interference." His definition of neurosis, however, is sufficiently clear for its use in practice.

As *Neurosis* we understand a chronic deviation of the higher nervous activity, lasting weeks, months, and even years. For us the higher nervous activity is manifested chiefly in the system of conditioned positive and negative reflexes to any stimulus and partially, but to a lesser degree, in the general behavior of our animals (dogs) (*88*, p. 73).

Pavlov's first descriptions (1923) of abnormal behavior as *neurotic* concerned changes in routine of the laboratory procedure.

If I have produced a process of excitation and now limit it with one of inhibition, this is trying on the animal; it begins to whine and bark and attempts to free itself from the stand. The only reason for this is that I have brought about a difficult *balancing* of the processes of excitation and inhibition. Let any one of us consider his own personal life and experiences and he will find many similar examples. If, for example, I am occupied with something—i.e., I am under the influence of a definite process of excitation—and if some one suddenly proposes to me to do another thing, it is unpleasant for me. For it means that I must inhibit the strong excitatory process in which I was engaged, and only after this can I start a new one. "Perverse" children are classical examples belonging here (*88*, p. 333).

But the first experiments from Pavlov's laboratory having to do with pathological changes following conflicting stimuli were much earlier. Those of Yerofeyeva in 1912 revealed the basic facts upon which years later Pavlov built his special concepts.

The conditioned food reflex was elaborated not from an indifferent agent but from a destructive one, evoking an inborn defensive reflex. The skin was irritated by an electric current and at the same time the dog was fed, although at first the feeding had to be forced. A weak current was applied which was later increased to the maximum. The experiment

[9] Korzybski has emphasized in "Science and Sanity" (from which arose Chase's "Tyranny of Words") the harmful effect of such verbal identifications.

ended thus: with the strongest current, as well as with burning and mechanical destru of the skin, there could be provoked only the food reaction (the corresponding m reaction and the salivary secretion) and there was no trace of any interference by the de sive reaction, there were no changes in breathing or heart beat, characteristic of this reaction. It is clear that this result was attained by the transference of the external excita to the food center and that simultaneously with this an inhibition of the center for defen reactions must occur. This special conditioned reflex persisted for some months and prob might have remained stable under the given conditions had we not changed them so that electric irritation was systematically transferred at every excitation to another new point the skin. And when the number of these points became considerable, then in one of our do the condition suddenly changed. *Everywhere, beginning with the first location of the stimulus and even with the weakest current there was manifested only the strongest defen reaction, and not a single trace of the food reaction.*[10]

The next observations of pathological behavior were reported by Shenger-Krestovnikova in 1921:

A conditioned food reflex was elaborated in a dog to a circle of light projected on a scre in front of it. Differentiation of the circle from an ellipse of the same size and intensity w afterwards tried, i.e., the circle was always accompanied by feeding; the ellipse, neve Differentiation was thus elaborated. The circle called forth the food reaction, but the ellip remained without effect, which is, as we know, a result of the development of inhibitio The first ellipse applied was markedly different in shape from the circle (the proportion o its axes was as 2:1). Afterwards as the form of the ellipse was brought closer and closer t that of the circle, we obtained more or less quickly an increasingly delicate differentiatio But when we used an ellipse whose two axes were as 9:8, i.e., an ellipse which was near circular, all this was changed. We obtained a new delicate differentiation, which alwa remained imperfect, lasted two or three weeks, and afterwards not only disappeared spo taneously, but caused the loss of all earlier differentiations, including even the less delica ones. The dog which formerly stood quietly on his bench, now was constantly struggling an howling. It was necessary to elaborate anew all the differentiations and the most unrefin now demanded much more time than at first. On attempting to obtain the final differentia tion the old story was repeated, i.e., all the differentiation disappeared and the dog fell aga into a state of excitation.[11]

[10] (The italics are mine, W.H.G.) Pavlov, I. P.: Lectures on Conditioned Reflexes, International Pu lishers, New York 1928, vol. 1, p. 341, 342. See also Yerofeyeva, M. N.: Electrical Stimulation of the Skin of the Dog as a Conditioned Salivary Stimulus, Thesis, St. Petersburg, 1912; Preliminary Com munication, Proc. Russian Med. Soc. in St. Petersburg, vol. 79, 1912.

Yerofeyeva, M. N.: Contribution to the Physiology of Conditioned Reflexes to Injurious Stimu Proc. Russian Med. Soc. in St. Petersburg, vol. 80, 1913.

[11] Pavlov, I. P.: Lectures on Conditioned Reflexes, International Publishers, New York, 1928, vol p. 342. Also see Shenger-Krestovnikova, N. R.: Contributions to the Physiology of Differentiation Visual Stimuli, and Determination of Limit of Differentiation by the Visual Analyser of the Dog, Bulle of the Institute of Lesgaft, vol. III, 1921.

Hypnosis and catelepsy in animals were described to the International Congress of Physiologists at Gröningen as early as 1913, but at that time they were considered only as a stage of inhibition and specialized sleep. In his Gröningen address Pavlov said:

> But the matter does not end here. Gradually the effect of the conditioned stimulus, which was more and more delayed, disappears altogether, during the period of its isolated adaptation. It can, however, again be made manifest if the setting in of the unconditioned stimulus is delayed a little more; then you see the action of the conditioned stimulus during the last added seconds. But finally the conditioned stimulus becomes utterly ineffective. At the same time a kind of *cataleptic state* develops in the animal (he appears indifferent to external stimuli and becomes fixed in a certain active pose); or, and this occurs oftener, irresistible sleep follows with complete relaxation of the skeletal muscles. The speed of development and the intensity of the phenomenon upon certain conditions—upon the absolute strength of the conditioned stimulus, upon the interval of time between the beginning of the conditioned stimulus and the unconditioned stimulus, and the number of repetitions of the delayed conditioned reflex. The individuality of the animal has considerable influence. Sleep and the cataleptic state will disappear if the unconditioned stimulus closely follows the conditioned stimulus (three to five seconds). One can hardly fail to see that these phenomena are intimately connected with the nature of hypnotism and natural sleep (*88*, p. 291).

By using the conditional reflex method as a measure for the function of the higher nervous activity in animals Pavlov was able to observe in his laboratory dogs deviations from the normal under certain natural episodes as will be described later.

Pavlov's work on the experimental neuroses expanded rapidly during the last decade of his life (classification of animals into temperaments, the production of conditions which he thought analogous to human psychoses—catalepsy, paranoia, epilepsy, neurasthenia, obsessions).[12]

Pavlov considered that in human neurasthenics and hysterics, the former are like dogs who are incapable of even weak inhibitions, and in the latter inhibition is so pronounced and localized that it takes the form of anesthesias, paralyses and increased suggestibility.

Most of the work from Pavlov's laboratory had to do with either anomalies of the conditional salivary reflexes or the pathologic motor phenomena; little was done on other autonomic functions or the interrelationships of the various systems.

Besides the scores of papers from Pavlov's laboratory in the past few years on the experimental neuroses, recently several American investigators have given serious attention to the subject. First among these were Liddell (*71*) (noteworthy for his work as the American pioneer in this field) and his collaborators. As early as 1924 Liddell turned to the application of the conditional reflex method in the

[12] For a detailed account of these the reader is referred to Pavlov (*89*).

study of the cretin produced by removing the thyroid in sheep. From that be- ning he and his collaborators (Anderson [2], James [72], Parmenter [3], Suth- land et al) have made a systematic investigation of the nervous disturbances variety of animals—goat, sheep, dog, rabbit, pig. Their routine observation made chiefly on the motor conditional reflex in the sheep. Comparisons of many species of animals show that the disturbance of behavior was a general pression of the conflict between excitation and inhibition, but that it took a so what different form in the different species. Liddell stresses the restraint of vo tary activity as a factor in the production of the "neurosis," as well as the vari with the species. Sleep was difficult to obtain, the neurosis being of the excita nature because, he suggests, sheep do not normally sleep as do dogs (*71*).

Anomalies in cardiac rate were noted. Genetic influences have been studied Stockard, James and Anderson (*102*).

Extension of the Pavlovian method has been made by Cook (*14*) Maier (and Mowrer (*86, 87*) to rats; Maier obtained cataleptic states similar to w Pavlov saw in dogs. Dworkin (*21, 22*), Masserman (*83*) and Karn (*61*) h described neuroses in cats; Finch (*91*) and Jacobsen (*59*) in the chimpanz Klüver (*65*) in monkeys; and Mowrer has worked on social relations in the An extensive review of the American work is to be found in Masserman (*83*).

II. METHODS OF PRODUCING "EXPERIMENTAL NEUROSES"; SUMMARY OF THE SYMPTOMS; METHODS OF MEASUREMENT

DISTURBANCES in behavior have been observed in experimental animals from a variety of causes, some of them accidental, others employed definitely as methods.

Pavlov gives the following summary of the causes of the neurosis:

> Further, with such an experimental animal it is definitely known that this insufficient balance, peculiar to the make-up of the particular animal, finally breaks down under certain fundamental conditions. This happens mainly under three conditions, three circumstances. Either extremely strong stimuli in the nature of conditioned stimuli are used in the place of those that are only weak or moderately strong and which ordinarily determine the animal's activity; i.e., its excitatory processes are overstrained. Or the animal is required to exert a very strong or a very protracted inhibition; i.e., its inhibitory processes are overstrained. Or, finally, a conflict between both these processes is produced; i.e., conditioned positive and negative stimuli are applied one right after the other. In all these cases with the proper animal there develops a chronic disturbance of the higher nervous activity, *a neurosis*. The excitatory type loses almost completely its ability for any inhibition and generally becomes unusually excited; the inhibitory type, though hungry, refuses even to eat under the influence of the conditioned stimuli and generally becomes exceedingly ill at ease and also passive with the least change of its surrounding environment (*88*, p. 84). see Pavlov

Liddell employed chiefly the third method which he subdivides into difficult differentiation, extinction, and variation of schedule. Maier working with rats has combined pain with difficult differentiation. note

In my summary below I have attempted a more detailed analysis, concentrating chiefly on the factors that have appeared in the Pavlovian Laboratory at the Phipps Psychiatric Clinic of Johns Hopkins University. I realize that the detailed classification of the various situations may not rest upon a rational basis, that it may represent associations in the mind of the experimenter rather than in the forces of nature and that subsequent work may reveal an underlying principle which would make such a classification superfluous.

EXTERNAL FACTORS 1.

a. Natural severe emotional shocks, such as situations involving extreme fear, explosions to simulate military situations, unusual scenes, prolonged and fierce fights, physiological states like parturition, disturbance in the male from the presence (or withdrawal) of a rutting female (see Chapter IV). Most of these states

would ordinarily be recognized by the term "emotional upset." Here the ditional reflex method is of great value in giving us a correlated measure of higher nervous activity to compare with what is observed by ordinary means.

b. Artificial Methods of Producing Experimental Neuroses:

1. By creating a conflict between emotions, or in the concept of Pavlov, tension between subcortical centers, or two unconditional reflexes, as between and pain.

2. By the conflict between opposing conditional stimuli—either a confl space or time, e.g., differentiations too difficult for the animal, or simultane application of positive and negative conditional stimuli.

3. Changes in the daily order and time relations of the routine.

4. Excessive increase of intensity in the conditional reflexes.

5. Change in relation between conditional and unconditional reflexes: fa to follow the conditional reflex by the usual unconditional stimulus. Though is a method of producing extinction, it may instead of leading to extinction bec a chronic state of disturbance.

2. INTERNAL FACTORS

State of the Animal (Emotional or Constitutional). Besides these d external causes stands the equipotential one, too often neglected, of the stat *the animal*, as a predisposing factor. This may be a temporary one, either e tional or physiological as hunger, sexual excitation, or parturition in the fem or it may be a permanent individual weakness of the nervous system which the present may be described as *constitution or temperament* without impl any fixed basis for a classification of constitutions. Included here are injuries the nervous system through traumata or endocrine disturbances, such as the t roidectomized animals of Liddell or the castrates of Pavlov.

The emotional state or attitude has been grossly neglected in most ani studies. The investigations are even purposely arranged to eliminate these disturbances. However their importance cannot be too strongly emphasi Owing to the lack of a sufficient number of well organized experiments on subject, I shall make only a brief mention of this factor in scattered refere throughout the book according to the material in hand. The emotional state partly under our control, such as in the hunger of the animal from whom we eliciting the food reflexes, but partly a result of poorly understood inte mechanisms, endocrine secretions, rhythms, etc. (Richter, *95*).

Pavlov recognized the importance of the emotional state in his reference "subcortical tension," "reciprocal relation between cortex and subcortex," but arrangement of his experiments plus his advancing years limited progress in direction.

SYMPTOMS

The symptoms of the animals studied by me and other workers fall into several categories. First, *general behavior*. Refusal of the animal to perform correctly the problem, or marked deviation from the performance has been most generally observed. Reluctance to enter the experimental environment is seen in both animals and children during difficult differentiations. Second, gross *emotional disturbance*, such as whining, barking, attempting to escape. Defense reactions may replace the food reflex as the basis for excitation. Third, *motor phenomena*, not components of a definite emotion. These varied from great hyperactivity to sleep, catalepsy, convulsions, tics. Fourth, *autonomic responses* (they have been less frequently studied than the motor). Change in heart rate was reported by Liddell and Gantt; frequency of urination by Liddell, Maier, Masserman, Gantt; defecation in pigs by Liddell; change in respiration by Liddell, Kellogg and Gantt; sexual symptoms by Gantt, Parmenter and Anderson. Fifth, changes in the special *relations between positive and negative* conditional reflexes. One or both may be suppressed, or one may predominate at the expense of the other, etc.

(1

(2

(3

(4

(5

The symptoms fall into four general categories in which the appropriate reactions (excitation or inhibition) are replaced by 1) direct active defense responses aimed at escaping from the situation; 2) passive defense, leading to immobility and various motor disturbances (catalepsy, etc.); 3) entirely unrelated and extraneous symptoms, having neither characteristics of the appropriate response nor an active or passive defense value—these symptoms constitute the various neuroses (permanent abnormal changes in the separate physiological systems), as circulatory, sexual, respiratory, alimentary neuroses. 4) Changes observable only by special measurements of occult autonomic functions.

Upon the latter we depend for the most delicate measurements of the imbalance in the animal. As one may deduce from the theoretical considerations of Chapter I, a disturbance in the organism can be reflected in the conditional reflexes of that system where the disturbance had its origin, e.g., with the food reflexes if the original focus was food. These conditional reflexes may be diminished or reduced to zero, but lacking such gross changes, we have more delicate measurements, viz., in the relationships of the different conditional reflexes. Thus the inhibitory conditional reflexes may suffer and not the excitatory, or vice versa; the strong and not the weak, or the ratios may be altered as described by Pavlov (paradoxical phases). Also the accompanying respiratory and cardiac conditional reflex records may show anomalies and chaotic relations instead of the previous regularity. As a rule the secretory and motor *unconditional* reflexes are not affected, but measurements of another important unconditional reflex prove to be a delicate barometer of the disturbance, viz., the sexual reflexes. Their susceptibility to imbalance in

note

other systems (e.g., food and defense) is in strong contrast to the relative im-
munity regarding susceptibility of the other unconditional reflexes.

Change in 24 hour running activity in the cages has also furnished a means
of chronic nervous imbalance. Besides the evidence in the sudden alteratio
the usual degree of activity is the lack of correlation between the activity
pathological animals with the normal.

In any measurement that we make—whether general behavior, motor, se-
tory, respiratory, cardiac, metabolic—it is imperative to recognize that *no sing
measure represents the whole picture.* We are, so to speak, fishing in the stre
of life, and bring up only that for which we have the appropriate bait.

The establishment of the laws of conditional reflexes in the normal anim
referred to in Chapter I, furnish the basis for detecting the pathology by obser
ing the variation from the normal. As the individual fluctuations are great, i
important to know the normal for any given individual before evaluating
measurements in a pathological environment.

A description of the laboratory rooms will facilitate the reader in understand
the experiments. The dogs are ordinarily kept in paddocks on the 6th floor in t
open air, either single and adjacent with only a wire partition, or together i
large open-air room. They are brought down on the elevator to the first fl
experimental rooms, consisting of a smaller soundproof room (no. 120) abou
feet square, referred to as *camera,* within a large room referred to an *antecame*
Rooms 528 and 529 are experimental rooms used for motor conditional reflex
exclusively, in an adjoining building to room 120.

For those who are not familiar with the laboratory routine in the formation
conditional reflexes the following brief account will serve for orientation. Do
are first given a month or more for habituation to the living conditions before a
experimentation is done. The parotid salivary fistula is then made, after the he
ing of which the dog is brought down daily to the experimental camera. At fi
he is coaxed in without forcing and fed for a few minutes there daily with the d
dog biscuit used to elicit the flow of salivation. After one or several weeks he
placed on the stand and fed from the food box for the first few days by han
When he becomes accustomed to this the leash is attached and a salivary c
fastened over the opening of the parotid fistula and all measurements (mot
quantities of secretion, heart rates, respiratory) recorded by the experimen
sitting on the outside of the camera. The dog is thus separated in the soundpr
camera from all adventitious stimuli.

After the above habituation of the animal to the environment has progress
so that he stands quietly, the routine experimentation is begun by giving audito
visual or tactile stimuli at intervals of 3-5 minutes. Each such stimulus ha
duration of 10 seconds, after which a measured amount of food is dropp

mechanically in front of the dog. The animal gets 10-12 such stimuli and feedings daily, spending 30 to 90 minutes in the closed camera.

After a *stable* positive conditional reflex, which requires from 1-6 months depending upon the animal, has been established, the development of inhibition (differentiation) is started. A similar though easily distinguished stimulus is chosen as a negative one to be differentiated from the former positive cs. Thus if M20 were the positive signal, M100 (metronome with a frequency of 100 per minute) might be the negative stimulus. Such differentiation may require another 6 months' period for stabilization. The measure of the inhibition is the amount of salivary secretion during the action of the negative stimulus, usually taken for 30 seconds. After one positive conditional reflex has been formed subsequent ones can be established more quickly. The measurements made are shown in Table 1.

TABLE 1

DOG: BILLY — 21 OCTOBER, 1931

Order of Stimuli Interval	Conditional Stimulus: Time	Conditional Stimulus: Conditional Signal	Conditional Stimulus: Number Repetitions	Conditional Stimulus: Duration in Seconds Isolated / Total	Orienting Reflex: Latent period (seconds) Strength	Orienting Reflex: Duration (seconds)	Conditional Reflex: Latent Period (seconds) Secretory	Conditional Reflex: Latent Period (seconds) Motor	Conditional Reflex: Size of Secretion	Conditional Reflex: Motor Reflex	Reinforcement (Unconditioned Stimulus)	Size Unconditional Reflex 60 seconds	General Behavior: Remarks
1	15:46	Bu	212	15/20	+1–15		>1	—	175	—	3 gms.	590	Dog sits quietly throughout experiment
2–8	15:54	Bu	213	15/30	+1–15		2	—	222	—	3	474	
3–4	15:58	Bu	214	15/30	+1– 5		4	5	225	+	3	475	
4–4	16:02	Bu	215	15/30	++3–15		3	—	250	—	3	530	

From the above it is seen that we have a measure for the intensity of both the cr and UR, the latent period of the cr (time after the beginning of the conditional stimulus that the secretion starts), and the motor component (turning of the dog toward the source of food during the action of the conditional stimulus).

In the development of the defense conditional reflexes (crs) a secretory measure may be made by injecting 0.25 per cent hydrochloric acid into the mouth 10 seconds after the beginning of the conditional stimulus (cs) instead of giving food.

Simpler than the above secretory methods is the establishment of the motor defense reflexes to a faradic shock to the paw. The cs is given for 1 to 3 seconds at intervals of 1-5 minutes, the dog being in a soundproof camera. The duration of the cs is always constant, i.e., either 1, 3 or 5 seconds, though the interval between the successive conditional stimuli varies from 1 to 5 minutes (in order to avoid the establishing of a time reflex). Any movement of the animal during the cs suggestive of or similar to the movement which the dog gives to shock is recorded as a motor cr. Its latent period is measured from the beginning of the action of the cs.

Although the motor defense crs are not routinely measured quantitatively[1] as

[1] Liddell uses the Fick accumulator to obtain a quantitative measure of the movements.

are the salivary they are easier to record, and it is not necessary to maintain a con- stant state of hunger in the animal as it is when one is using the food reflex; with the latter, this is essential (to produce tension in the food center the animal is ordinarily starved for 22 hours before the experiment, receiving his daily ration as soon as he is returned to the paddock). Furthermore in the technic we have developed here we probably possess a much more delicate measure excitation than is possible with any method for muscle movement except an elec- trical one for action current. The cardiac cr (Gantt [46] and Gantt and Hoff- mann [42]) which I have been using for several years as a measure is apparently more responsive than any other cr record.

not

It is important to remember that the cr whether it is secretory, motor, cardiac, or respiratory, is measured during the action of the cs, and the unconditional reflex (UR) is measured after the dog receives the unconditional stimulus (US), the food, the acid, or the shock.

For a fuller description of methods see the excellent book of Hilgard and Marquis (*55*), Podkopaev (*93*), Liddell (*72*), and Gantt (*30*, *33*).

III. PRODUCTION OF DISTURBANCES IN BEHAVIOR BY NATURAL EMOTIONAL SHOCKS; TRAUMATIC AND EXPERIMENTAL WAR NEUROSES

Many events occur during even the controlled laboratory life of the dogs, especially if they are not kept in separate paddocks, that have a profound effect on the behavior of the individual. Ordinarily this might pass unnoticed but where a detailed careful study is made slight deviations from normal appear in the conditional reflex interrelations, calling attention to the disturbance as well as measuring it more delicately than any ordinary observation can. By following the dogs over a large part of the life-span and the making of daily conditional reflex measurements, I have been able to detect frequent abnormalities of behavior and to find the causes in some experience of violence.

Doubtless innumerable instances of nervous behavior have been seen in domestic animals from time to time, but owing to lack of careful observations of the symptoms, of the isolation of causes, and more particularly of the use of a satisfactory and delicate measure such as we have in the crs, they are not available in the literature for study and comparisons. Several verified examples will be given later in this chapter.

Physiological conditions that cause a change in the crs are the postpartum state in the female and sexual excitation in the male. Pregnancy is without effect up to within a few hours of labor. In many females who had had good differentiation up until or shortly before parturition, for several days postpartum there was a lack of differentiation between positive and negative crs as well as some panting and restlessness while the dog was in the experimental camera (Table 2). (1

TABLE 2
Kompa

15 Dec. 1930	M60(+)=105	M144(−)= 30
29 Dec. 1930	Puppies born	
2 Jan. 1931	M60(+)=100	M144(−)=160
5 Jan. 1931	M60(+)= 75	M144(−)=150

After pregnancy a loss of differentiation is seen.

A similar disturbance was observed in a quiet stable animal, Zee. Although there was no change in her observable motor reactions to the positive tone 256 and the negative tone 512, a comparison of the cardio-respiratory crs shows a chaotic relationship shortly after labor. This dog had puppies on the night of 16 April. When she was tested on the morning of 17 April there was increased heart rate as

TABLE 3

COMPARISON OF CR HEART RATES: DOG ZEE

	10 Mar. 1942		17 Apr. 1942		24 Apr. 1942	
	Control	No. readings	Postpartum (10 hr. after labor)	No. readings	1 week post-partum	No. readings
Ht. rt. before test	83	3	112	11		
Ht. rt. in control interval	81	78	112	52		
Ht. rt. before+cs (control)	75	10	104	10	73	5
Ht. rt. during+cr	100	10	110	10	94	10
Ht. rt. before−cs (control)	78	10	106	10	77	10
Ht. rt. during−cr	100	10	126	10	94	10
Ht. rt. during UR	101	10	117	10	88	10
	Quiet		Restless		Quiet	

well as a failure of the normal differentiation between the control heart rate and the heart rate to the positive cs, i.e., the heart rates on the 17 April did not show the normal relationship that they did previously, as can be seen in Table 3.

On the 10 March (during pregnancy) the increase in heart rate with

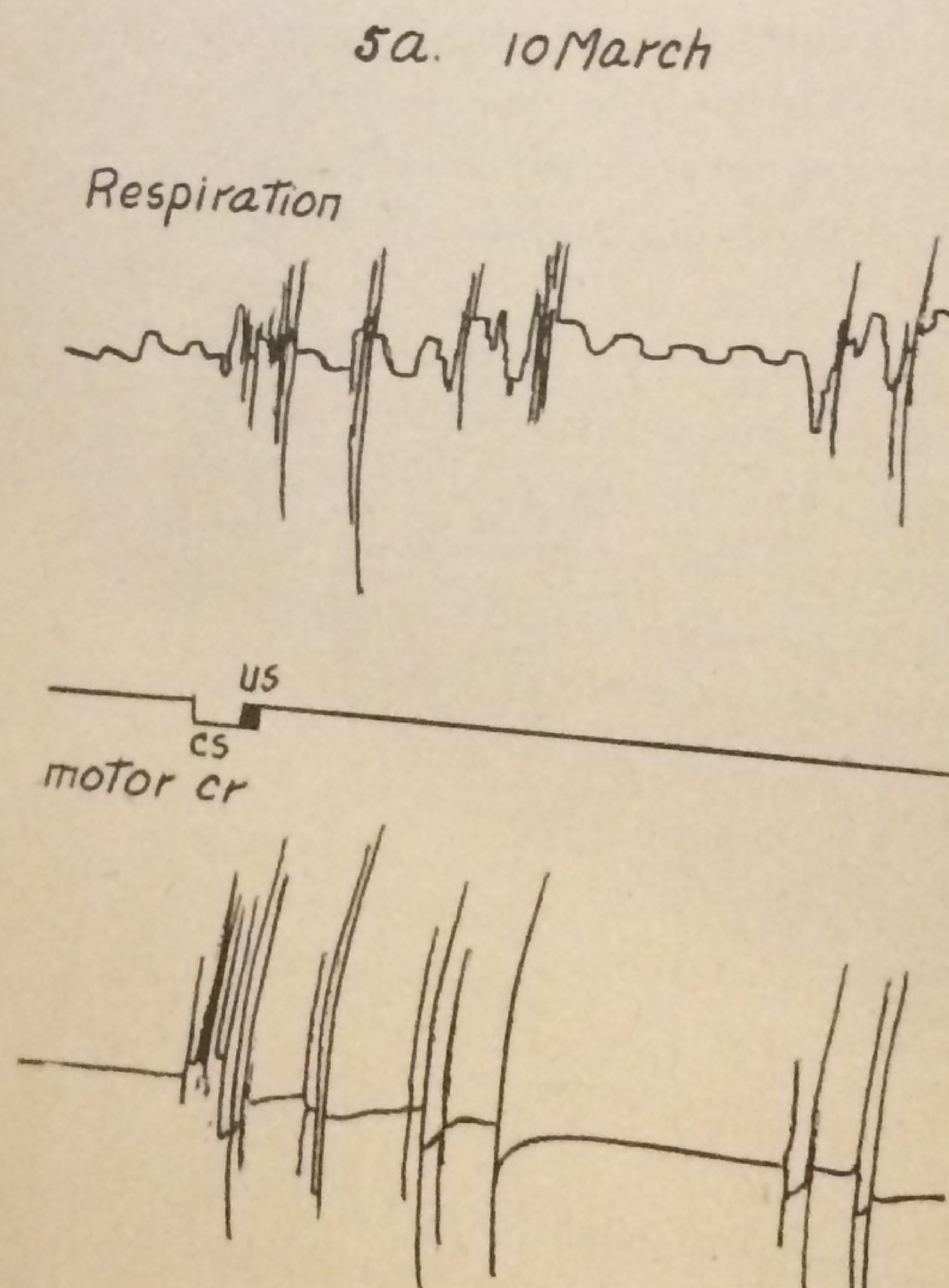


FIG. 5a.

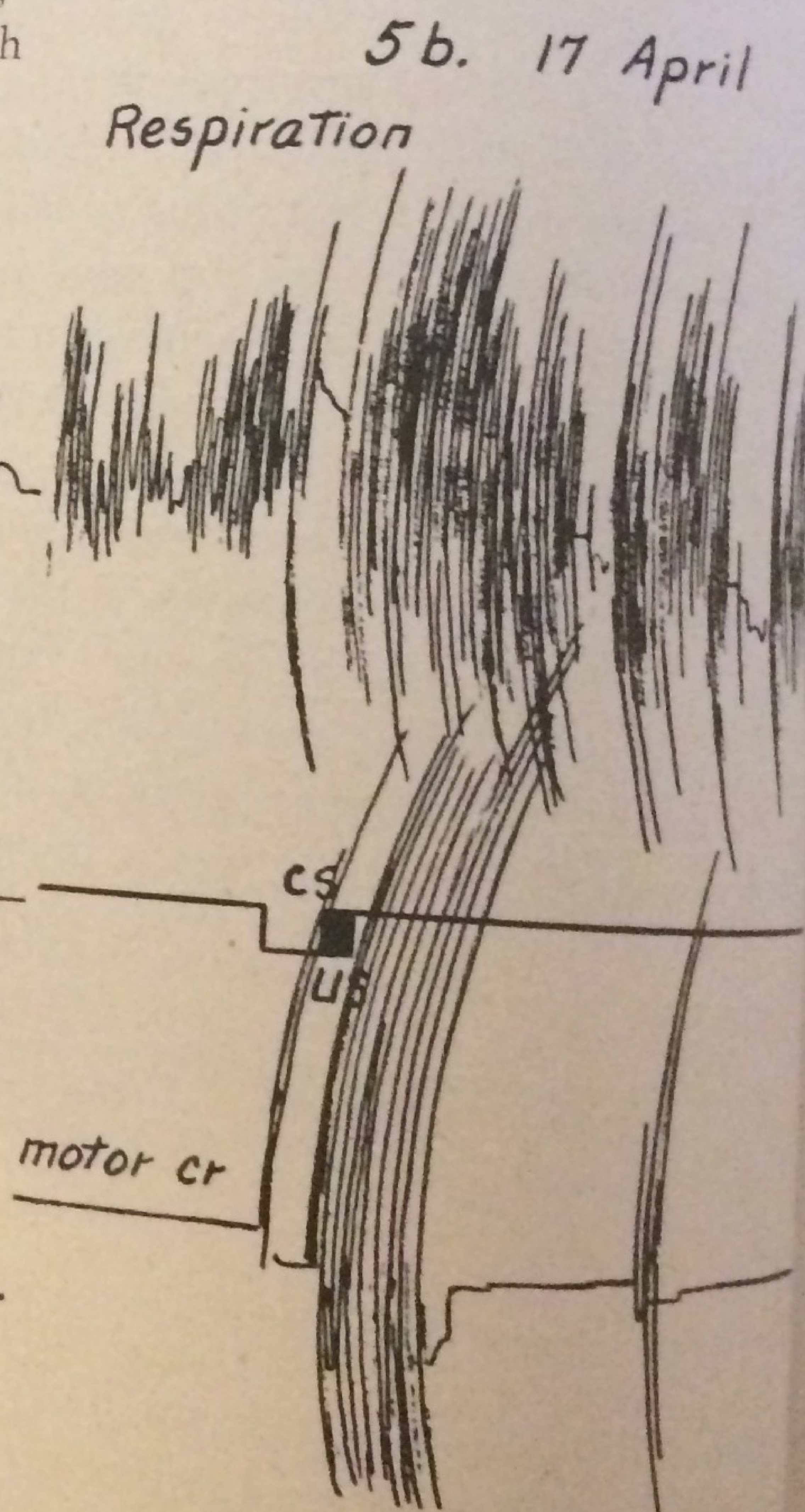


FIG. 5b.

the positive cs was from 75 to 100 (33⅓%), with the negative cs 78 to 100 (28%); while postpartum on the 17 April, the increase of the heart rate was with the positive cr only 104 to 110 (6%) and with the negative cs paradoxically more than it was with the positive cs, viz., 106 to 126 (19%). One week after birth of puppies the cr heart rates were approximately the same as during pregnancy.[1]

There is a corresponding change in the respiratory rates on the three days as is seen in the records below; the rate on 10 March is approximately 20 per minute, on 17 April 150 per minute, and on 24 April the respiration was again normal with short intermittent periods of panting (figs. 5a, b, c).

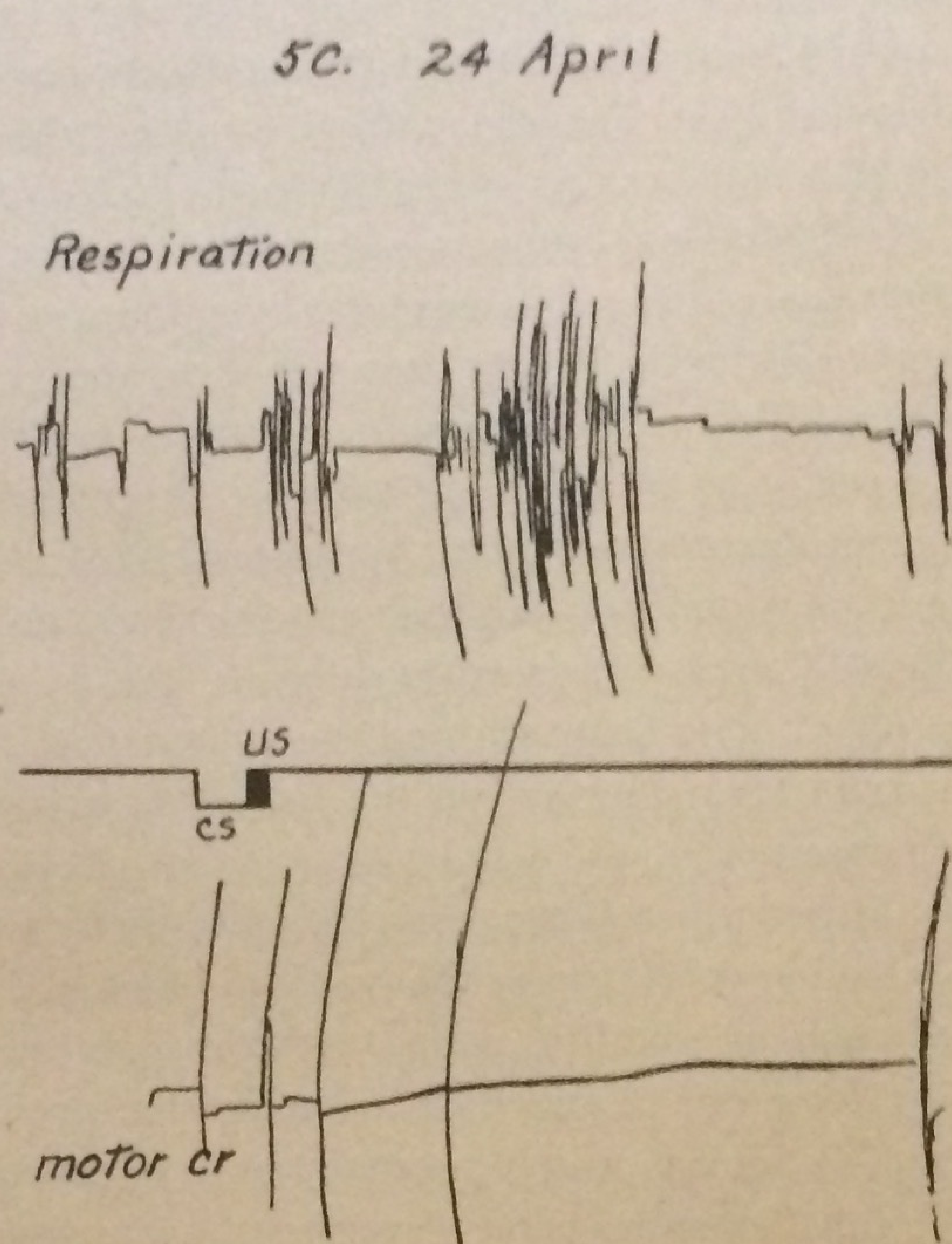


FIG. 5c.

FIGS. 5a, 5b, 5c. Respiratory response and motor reflexes in dog Zee a) in late pregnancy, b) 10 hours postpartum, and c) one week postpartum. Note the greatly increased respiration rate and the more frequent and intense movements of the leg in Fig. 5b.

The stimulation of being in the same room or near a female in estrus has a powerful effect upon male dogs. Not only does it affect their behavior, making them more restless and hyperactive, but it has a marked disturbing effect upon the crs. Thus a dog Bamech in the same room with a female in estrus (in which there were also many other dogs) would not eat that day in the experimental camera. At this time he likewise showed marked restlessness—turning around on the stand, jumping up, backing off. Furthermore the secretory crs became paradoxical, i.e., the weaker ones were stronger than the formerly strong ones. (Experiments of Dr. Dworkin. Ch. IV, see Table 5.)

As pointed out in the discussion of Nick, the sexual excitation in a female dog has a less powerful effect as an inhibitor of other functions than it does in the male. Thus a bitch continues to accept food in the presence of a male during estrus and

[1] The equality of the positive and negative cr heart rates was due to the fact that Zee did not differentiate on any of the above days between the excitatory and the inhibitory csi, i.e., she lifted her foot to both positive and negative csi.

even during coition, although a male is capricious about taking food in the p ence of the female in estrus, refusing it completely during coitus. However is no effect upon the secretory crs in the male shortly after copulation (37) these observations it has not been possible to analyse what might be impo factors such as the presence of other male dogs, frustration, etc.

2) Besides physiological states and the occurrences that upset the animal *infra*), in a series of dogs fearful influences were introduced, simulating the and fright of war and bombing. A striking example of the accidental type of normal behavior occurred in the Pavlovian Laboratory at the Johns Hop Medical School in 1931. About 15 dogs were accustomed to being kept toge in two paddocks on the sixth floor. They were always brought down singly leash to the experimental camera on the first floor. On Sunday, 19 April, 1 they were discovered roaming over the 3rd, 4th, 5th floors in groups, the d to the paddocks having been left open apparently on Saturday night. On hea the pandemonium—barking, fighting—the night watchman was met at the of the steps by growling animals which he said were like a pack of wolves tempting to attack him. A panic resulted in which he clubbed the dogs be getting them back into their places around noon. His attitude was described w he said there was so much difficulty that he would have shot them if he had a pistol. The next morning the animals had more or less severe injuries, bru sprained legs, gashes on the face, etc., from the beating and the scuffles am themselves.

Following this weekend debacle, there was a marked change in the gene behavior as well as in the crs of the animals. Furthermore the alteration in the behavior and crs varied with the constitutional temperament of the dog, l ing from one or two days in the milder cases to a week in the severe, after wh time it became nearly normal except in one of the dogs, "Blue."

The following three dogs showed contrasting and interesting changes:

"Kompa" ordinarily was a lively animal of the excitatory type, continu jumping around, playing, sniffing for food; never quiet a moment except w in the experimental chamber. On 20 April the day after the escape, she was so what subdued in her activity, but more active than any of the other animals.

Formerly there was a good differentiation to the metronome as shown in protocol for 17 April, i.e., there was no secretion ordinarily to M140 (negative never followed by feeding), though a secretion of 150 to M60 (accompanied feeding). After the panic, on 20 April the secretion at 14:33 o'clock to M140 60 seconds was 75 instead of 0, and at 15:02 the secretion was 50 instead of The secretion to the positive crs was unchanged. On 22 April the secretion 15:00 to M140 was 25 for 60 seconds, and at 15:22, 13 mm.; on 24 April mm. at 15:07, and 63 at 15:27. Comparing these readings with the nor

protocols on 15 April, before the accident, we find that the reaction to M140 was only 5 mm. secretion, i.e., nearly perfect inhibition.

This dog, of the excitatory temperament, under the stress of the disturbing experience, suffered only a slight decrease of her positive (excitatory) reflexes, but the inhibitory or negative ones were transformed into excitatory ones, shown both by the salivary secretion and the substitution of restlessness for the usual sleep with the inhibitory metronome. Previously it was seen with Kompa, that the inhibitory reflexes were much more unstable, i.e., they changed their character completely or fluctuated more from day to day than the excitatory; these later were strong and persistent, not changing after several months' interval.

The next dog, "Blue," usually a lively, playful animal, varied greatly however in his mood, being easily offended, often seclusive and fearful and always disobedient. Judged by the speed of formation of crs, his intelligence was about the same as that of Kompa but his retention was not so good.

After the accident of 19 April he suffered a serious change. He could be brought only with difficulty into the experimental room, although generally he ran there with avidity. Instead of scampering about and playing before being put into the camera as he ordinarily did, he crouched in the corner with tail tucked, back arched, and would not come out when called or offered food, did not jump upon his master as usual; sat in the corner for an hour at the time, resisted being brought out, hung his head and could not be induced to look up at the experimenter. When we moved him out of the corner in an attempt to play with him, he slunk back as far out of sight as possible. Although he generally went eagerly for a walk, now he resisted; he did not tug on his leash as usual but had to be coaxed. He ran away from the other dogs with tail tucked. This behavior was most marked on 20 April, returning gradually to normal. On 27 April he was playful again, jumping on the chairs and on the experimenter, but in a more subdued way than formerly.

When put into the experimental camera he was very quiet instead of lively and playful. For the week following there was no barking or playing whatever. The crs (which were present on the 16 and 17 April, though rather irregular then) showed marked alterations: to M20, the stronger of the csi, they entirely disappeared the day after the episode; and to the weaker cs (Bu), they were greatly diminished (both of these were positive csi). Furthermore there was a reversal in the normal reaction to these stimuli, in that he usually gave a larger secretion to M20 than to Bu, as the former was the older, having been repeated 104 times while Bu had been used only 14 times (date of 20 April). This phenomenon will be met later as the "paradoxical phase" of disturbance in the normal relations of the crs. On the 24 and 25 April the crs returned, but they were smaller than they were before the 19 April, irregular, and not even present every time.

In the protocol for the 27 April, we see that they had all returned, and moreover approximately of normal intensity for this animal.

The third dog, "Billy," was a bull terrier, the cleverest of any of our elaborating the cr after two trials and becoming regular in his reaction to the after eight repetitions of the stimulus with food. He was also well balanced, ing differentiations easily in contrast to Kompa and Blue.

Obedient, purposeful in his movements, orderly, and accurately responding situations, he was altogether a well disciplined animal—not playing unless vited to do so nor jumping on his master except when called, in contrast to who tore up paper, jumped around on the chairs, tables, and food box, twisted the loops; on the contrary, Billy would sit quietly in the experimental camera hours. But on appropriate occasions he was playful and vivacious, running eager into the camera, tugging and pulling when taken for a walk. Extremely jea with the other animals, he often fought severe battles with them, in spite of fact that he had received serious wounds from these scuffles himself, having a perforation through the cheek, a badly bruised leg, lacerated ear, etc. He we ered these vicissitudes well, however, showing little change in his behavior or his reactions to the conditional stimuli. There is justification, in contrast to and Kompa, in saying that he has a strong, well-balanced nervous system.

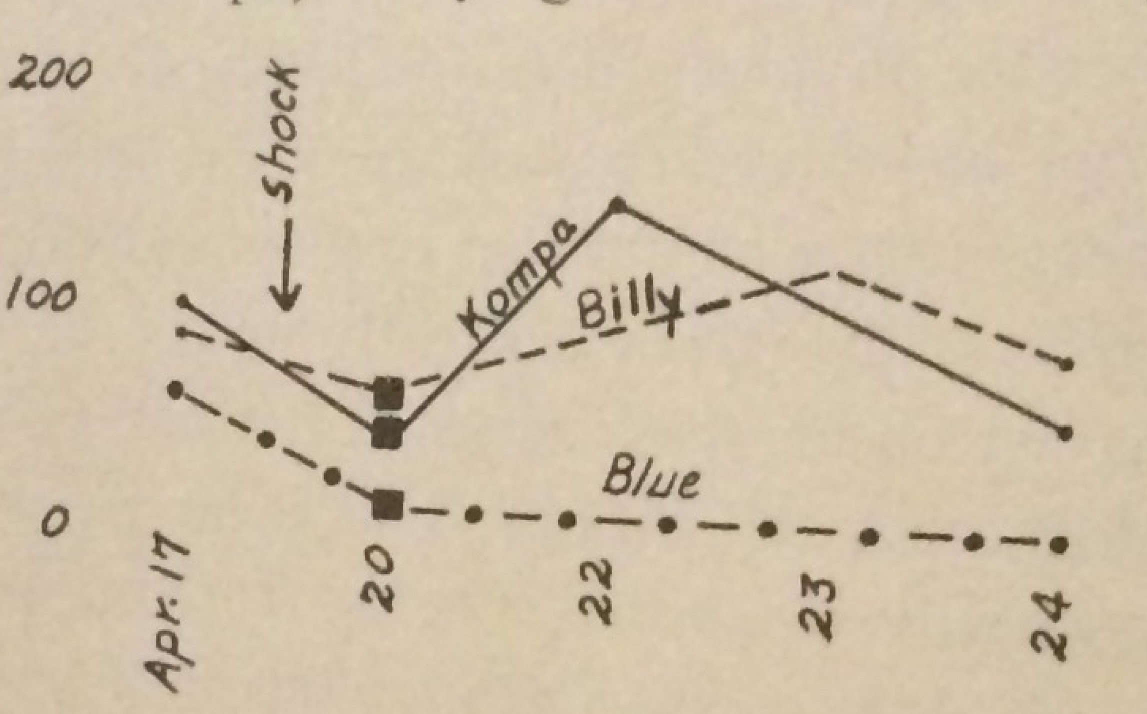


FIG. 6a. Effect of natural emotional shock (escape from paddock) on cr in 3 types dogs—excitatory labile (Kompa), stable (Billy) and inhibitory labile (Blue).

After the debacle of 19 April the dog's behavior changed only slightly compared to the other dogs. He was somewhat less active and playful than normally; he did not play when brought down, nor tug as vigorously on the leash when taken for a walk. The crs were altered very little—slightly decreased and less well differentiated, but only for the one day 20 April (fig. 6a).

Summarizing the effect of the pa on these three animals of different temperaments:

First, the behavior of all three was altered somewhat. This was shown in both the general behavior and the crs.

Kompa, a strong excitatory type having a capable nervous system for excitatory stimuli, in that the positive reflexes are nearly always active and present, showing a slight change in her behavior and for four days a breakdown in her reaction only to the inhibitory or negative stimulus.

Blue, who was frequently irregular in his reactions and almost neurotic his behavior at times, sometimes very excitable, became excessively subdued

depressed for the whole week, almost comparable to a deep depression (while Kompa was always excitable). Experimentally he had a complete loss of crs, reversal of effect of the strong and weak stimuli from the first day (Pavlov's paradoxical phase), and irregularity for the entire week, with gradual recovery. His general behavior also showed progressively less depressive reactions, but remained abnormal throughout the week.

Billy, with a strong, well-balanced nervous system, showed very little change in his behavior and even less in the crs, returning to normal in two days.

Confirmatory of what occurred in these three dogs in April 1931, there was later another similar disturbance. In attempting to produce an artificial neurosis (experiments with Oskar Diethelm) we subjected Kompa and Blue to attacks by fierce bull-dogs. With Kompa the attacking dog (Lady, referred to subsequently) was muzzled as otherwise she would have speedily killed Kompa. With Blue we allowed the dog (Billy) to attack unmuzzled, but we muzzled Blue, and removed the attacking dog by strangling whenever there was danger, although the long hair of Blue was a partial protection. Kompa and Blue were tied in a corner so that they would not escape (Table 4).

TABLE 4

SUMMARY OF EFFECTS OF FIGHTING ON LABILE AND STABLE DOGS

	BEFORE FIGHT			AFTER FIGHT		
	+cr	−cr	UR	+cr	−cr	UR
Labile Dogs						
Blue 1932	40		550	0		680
Kompa 1931	165	20	415	165	75	550
Kompa 1931	115	0	540	120	50	615
Kompa 15 Mar. 1932	150	0	545	0	0	390
Stable Dogs						
Lady 1931	260		160	240		160
Billy 1932 (a)	400		700	450		610
Billy 1932 (b)	250		250	200		180
Billy 15 Mar. (c)	50		520	65		525

(a), (b), (c) = csi of different intensities.

Both Blue and Kompa attempted to escape, but finding that impossible they became prostrate, snapping back ineffectually. There was marked dyspnea. The panic was intensified by kicking Blue and Kompa, though not painfully, during the fight.

The results were parallel to what was seen before. With Kompa there was in the two experiments very little change immediately after the struggle in the positive crs but a slight breakdown of inhibition. The positive crs were remarkably stable, the Bell (Be) giving 165 before the assault and after it at 16:38 a secretion of 164 and again at 16:55 a secretion of 165. The second time the fight was staged

the bell gave 113 at 14:24 before the attack, and a secretion of 130 at 14:44 minutes after the attack, a secretion of 126 at 14:53 sixteen minutes after second attack. This variation is less than what we usually get in our measure on normal days.

note

The intravenous injection of 1 cc. of adrenalin in Kompa apparently pro the same type of disturbance in the crs as the fight, viz., little effect on the tive conditional reflexes but conversion of the negative into excitatory. (Ex ments of Oskar Diethelm, 1931). This was not due to an effect upon the se tory glands because the URs were not increased. (See Table 22).

With Blue the story was different. The fight took place on 4 January, after the routine tests had been made. At 16:30 Billy and Blue were brought together. Billy, a fierce Pit Bull Terrier was allowed to fight Blue who was m zled. Blue lay on the floor where he was tied, bared his teeth and tried to esc Though Billy attacked Blue vigorously he did not injure him on account of long hair. Blue was kicked, though not painfully, during the fight by the perimenter. When Blue was tested even two days later, it was seen that all 5″ crs were absent except the second one. This is an occurrence that had not h pened since Blue's crs had become well established several months ago. On 7 January the 60″ measurements of the stimuli Bu and M20 were practic equal, closer together than they had been since the first day of regular differen tion; their normal ratio is 7:10. This is, as we shall see later, the phase of equ zation—a pathologic stage less severe than the paradoxical phase noted earlie Blue.

In the attacking dogs Billy (the stable animal of our first series) and L there was no change in the reflexes recorded on the day following. Table 4 il trates these changes in the various dogs.

Another instance of a natural conflict between two of the above mentioned d Kompa and Billy, occurred on 18 March, 1932. These animals were engage a prolonged battle, probably lasting for 12 or more hours. They were seen severe fight at 7:30, and again at 14:30. The description given of the two ani at that time was:

"Billy was holding on to Kompa's leg who was trying to pull away. Both d were severely wounded, too weak to stand up, but lying down fighting. B there were gashes on ears and cheeks, the face was swollen when brought into experimental room at 17:00; he did not play, nor run about nor jump up nor b as he usually does but was much subdued though not nearly so much as Komp for he ran into the camera, jumped on the table by himself and came when ca When coaxed he put his forefeet out toward the experimenter. But he was lively, walking slowly and jumping only feebly for crackers. *Kompa:* there w eight deep tooth gashes on her legs extending into the second layer of the fa

The wounds on Kompa and Billy seemed of equal severity. They were brought down together to the experimental rooms and they seemed equally weak physically. Kompa could barely walk; very much subdued she lay down, ate very slowly, would not jump on the stand as usual, was very sluggish in her movements, would not come when called nor jump for crackers, kept tail tucked, would not jump from the stand but had to be lifted down. The behavior of Kompa was much more subdued on this date even than it was in 1931 after the escape from the paddocks described above."

As seen from the protocols preceding the fight, immediately after the fight on the same day, and on the next day after the fight, as well as from the chart, the crs of Billy were only slightly diminished, and on the day after the fight about normal. But the cr activity of Kompa was markedly affected. The excitatory reflexes were reduced to 0, and the inhibition (M140) was also weakened; this inhibitory stimulus usually produced sleep but after the fight the onset of sleep was delayed, which delay was not attributable to the external inhibition of the painful effects ("distraction") because there was some sleep in the intervals between stimuli. In both the dogs there was only a slight change in the URs, i.e., the secretion to the food after the animal begins eating. On the 19 March Kompa was much better and more lively, she jumped on the table without assistance, but would not stand on her hind legs, as was her custom, for food. Her activity was still retarded, all the movements were slow and subdued, but she was in a better mood than on the day before; instead of tucking her tail she wagged it and even jumped up for food sometimes. On 21 March, Kompa was lively and playful as usual, jumping up and rolling over in play, etc., although there were still two open wounds; the others had closed (Table 4, fig. 6b). note

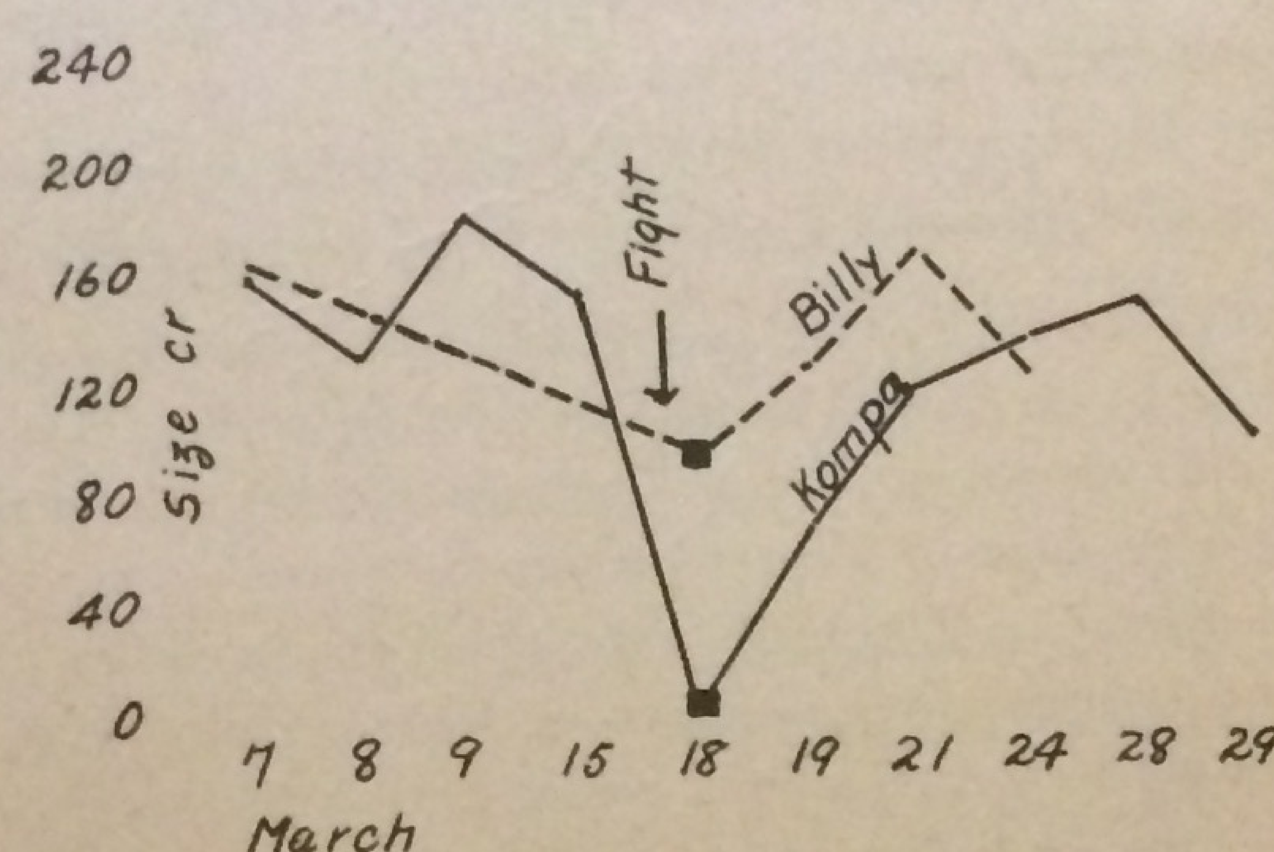


FIG. 6b. Effect of fight on crs in stable dog (Billy) and labile dog (Kompa). Cf. Table 21a.

The mere fact of fighting was not sufficient to cause the loss of balance in Kompa; for on 13 January Kompa killed a dog in her paddock, and the next day the conditional reflexes were normal.

Furthermore, this loss in the cr activity seems definitely attributable to the emotional strain of the fighting rather than to the pain *per se;* for I have noted in other animals that after many painful operations there is only a slight change

in the conditional reflex activity and emotional balance. For example, in a dog whose eye was enucleated on account of ophthalmitis on 22 April, 1932, a very slight drop in the conditional reflexes occurred even the day after operation.

The above animals showed also corresponding changes in their susceptibility alcohol (*30*). Though the moderate doses had approximately the same on all the dogs, the large doses caused more change in Kompa and Blue th Billy. No. 3 upon whom the alcohol had the most effect, was a pathological having had part of the cortex removed from both hemispheres.

It is important to note that the relations between the crs are changed in nervous disturbances and that this is a much more reliable index than the ab value of any one cr. Thus with Kompa the excitatory crs remained stable but inhibitory were destroyed; with Blue the strong crs were affected sometimes the weak were unaltered.

In agreement with these natural experiences are the observations of Pa made after the Leningrad flood and described as follows:

> The action of an exceedingly strong and unusual stimulation (for example the flo 1924) on dogs with a weak nervous system, having a predominant inhibitory proces other words on a central nervous system with an increased tonus of inhibition, repro the etiology of a special traumatic neurosis. . . . In September 1924 a great flood occurred in Petrograd afforded us the opportunity to observe in our dogs the prol neuropathological disturbances which developed as a result of the extremely strong unusual external stimuli consequent on the flood. The kennels of the animals which on the ground at about a quarter of a mile from the main building of the laboratory flooded with water. During the terrific storm, amid the breaking of the waves of the ing water against the walls of the buildings and the noise of breaking and falling trees animals had to be quickly transferred by making them swim in little groups from the ke into the laboratory where they were kept on the first floor, huddled together indiscrimin All this produced a strong and obvious inhibition in all the animals, since there was no ing or quarrelling among them whatever, an otherwise usual occurrence when the dogs kept together. After this experience some of the dogs on their return to the kennels sh no disturbance in their conditioned reflexes. Other dogs—those of the inhibitory typ as disclosed by experiments on their conditioned reflexes for a considerable period of t

Furthermore Pavlov could reproduce the effects of the shock (*88*, pp. 344, 364).

> Then we adopted the following course. Our experiments with conditioned reflexes now usually conducted so that the dog remains alone in the experimental chamber, the experimenter is seated outside the door in another room. From here the various are made to act on the dog: by a certain mechanical device the vessel of food is swung his nose, and here on the outside of the door are registered the results of the experiment. Speransky sat quietly inside the room with the dog, but did nothing else, while I, inste

him in the outer room, performed the experiment. The conditioned reflexes, to our great satisfaction, reappeared, and the dog began to take the food. We restored the animal to his normal condition. Next we tried the effect of a certain component, so to speak, of the inundation, by reproducing it in miniature. Under the door of the experimental chamber we allowed a stream of water to trickle. Perhaps the sound of the running water or its reflection threw the dog into the former pathological state. The conditioned reflexes vanished as before and their restoration had to be brought about by the means employed previously.

Moreover, when the dog had recovered, it was impossible to elicit an effect from the former strongest of all the conditioned stimuli, viz., the bell. It was inhibited itself, and afterwards there was inhibition of all the remaining conditioned reflexes. A year elapsed after the flood, and during this time we carefully protected the dog from every kind of extraordinary stimulus. Finally in the autumn (of 1925) we were able to get the old reflex, even to the bell. But after the very first time the reflex began gradually to decrease, although it was employed only once a day; and at last it disappeared entirely. At the same time all the remaining reflexes suffered, now temporarily vanishing, now passing into various hypnotic phases[2] ranging between the waking state and sleep although in this dog the latter state was never fully attained.

From all of these experiments it is evident that a variety of events accompanied by strong emotional upheavals can produce marked changes in the behavior of the animal. Moreover, this is characteristic for the individual animal, and it is observable not only in the general behavior and mood but can be more accurately measured by the changes in the absolute intensities of the conditional reflexes as well as in their relations to each other. Both the duration and the severity of the upset were closely *correlated with the type of animal*. In none of our dogs did this kind of upset last more than several weeks.

Thus in our three dogs of apparently different temperaments we meet with varying results as measured by the crs when subjected to similar severe emotional disturbances. Although the first episode occurred by accident we were able to duplicate the same effect in the corresponding dogs after an interval of seven months.

The fact that the changes depend upon individual peculiarities described as constitution or temperament or at least upon the individual gives experimental support to the emphasis laid by Hippocrates as well as by modern psychiatrists on the thorough study of the individual in preference to fitting cases into clear-cut diagnoses and well made theories; "nothing in psychobiology is absolute." (Adolf Meyer, *91*.)

The restrictions of the laboratory life may itself be a potent cause of nervous disturbance in dogs just as metropolitan culture is a great strain on the human being as is shown by the increase in psychoses in urban areas, as well as by the increase of irritability and other minor symptoms; although the laboratory life does not have an injurious physical effect on the dog, as can be seen from the instances

[2] Cf. with the paradoxical phase in Blue.

of dogs which have lived in the laboratory in health during experimentation, normal digestion as long as 12 years (Pavlov's dog) and several of my dogs are still healthy and working after 8 (Kompa, Sechs) to 13 (Nick) years' la tory life.

4) However, simply bringing the animal to the confinement of the laboratory impose a hardship upon its nervous system. In several of our animals bro from the Virginia farm to the Baltimore laboratory, marked depressive or hy active symptoms have been seen. Thus Brenda, an American bull terrier, who been raised by me from puppyhood, was kept on the farm until 4 months old she was brought to my house in Baltimore. Here, though with only a small (20 feet by 30 feet) in which to run, she appeared almost as normal as on farm except for the fact that she would not come into the house; but when to the laboratory and put in a cage about 8 by 8 feet she showed marked chan For 3 weeks she lay almost continually in one place in her cage, getting up to eat, drink, urinate and defecate. Even when brought out into the big adjoi room she stood motionless as a statue, with legs akimbo, trembling, head h tail tucked, completely unresponsive to my coaxing.

This immobility was so amazing that a collaborator (W. C. Hoffmann) s "You should have a movie of that dog. When you describe her in words no will be impressed nor understand how abnormal this dog was, standing absolu motionless with tail tucked and head hung for many minutes."

This dog never became normal in the laboratory, wasted away, refused t and finally died, after 4 months in a depressed state, although her activity creased somewhat as seen in the chart (fig. 15). As the same cycle was sh on several occasions by removing Brenda back to the house and again to the labo tory, it could not be considered a chance episode.

Although Brenda undoubtedly was a dog of psychopathologic constitu somewhat the same behavior has appeared in normal dogs. Thus a one year male pointer brought from the same farm to the laboratory also showed a mar reduction in activity but not the other pathological traits that Brenda did.

In both these dogs of the hypoactive type the laboratory caused greater in tivity. The noxious effect of the laboratory was not always in the directio underactivity; for example, the neurotic animal Nick, an extremely hyperac type, always showed increasing activity when brought from the farm to the labo tory. Evidently the direction of change in activity is a result of "constitution."

Another instance similar to Brenda was brought to my attention by Dr. K After the death of his father, the bereaved pet dog would not leave the house walks or exercise with other members of the family, remained constantly near former master's room, became more and more dejected, ate less and less in s of choice food and coaxing, wasted away and after two months died.

As other examples of prolonged disturbed behavior outside the laboratory

following may be mentioned. A young cat in my home with her first litter of kittens a week old refused for four days to nurse them after a puppy had lain in the basket, and even spit when brought near them.

One of my strong work horses was handled differently than he was accustomed to. He had always been driven by the reins and this time (for the same type of work) he was led by the bridle by a stranger. He instantly began to lather and to heave. On reverting to the former method of driving him, his breathing became normal and he stopped sweating.

One of my cows has the habit of tossing her head up when she is eating dry feed, thus scattering part of the feed out of the trough. In order to make her eat dry feed with the head down I placed a broomstick a little above her head while feeding. Immediately she began to lacrimate while eating and gave $\frac{1}{7}$ less milk on the first milking, $\frac{1}{3}$ less on the second and $\frac{1}{2}$ less on the third and fourth milking. The lacrimation increased and on the third day she went off her feed and became so dangerously constipated that a heavy dose of epsom salts was required. On letting her go back to her old habit of feeding, her droppings became normal and in two days she gave the usual amount of milk.[3] (Aluf de Ghize [*91*])

Though investigations are now being made on the effect of war conditions on different types of individuals, certain experiments simulating the explosions and fright of war have already been performed. The intercanine fights as well as the unkind treatment referred to previously reproduced some of the elements of war and battle. In addition dogs were subjected to loud explosions plus the fright and insecurity of being placed in a swinging hammock while in the experimental camera.

Details of the results obtained in three dogs will be given later under the accounts of Fritz, Peter and Nick (Ch. V). These dogs, who had been previously subjected to the strain of a difficult differentiation between food signals, had an extra load placed upon them by exploding firecrackers or shooting blank cartridges close to them in the closed camera. In two of them only a slight exacerbation of the nervous symptoms was observed. However, this change was only one of degree; the character and pattern of the pathological responses was unaltered. In the third dog, Nick, the symptoms were more aggravated than in the others. With all forms of stress the stable dogs have remained stable except temporarily.

In view of the fact that explosions and painful physical conditions imposed on the dogs apparently seemed much more severe than simply differentiating between two food signals, it is remarkable that the latter are yet more potent than violent physical causes in producing a breakdown.

The important fact is that the stable are always stable and the labile are always susceptible—a statement which will be amplified in Chapter VIII.

[3] I am indebted to Dr. Hugh Josephs for bringing this account to my notice. Although the disturbances are more in the nature of acute emotional changes than of chronic pathologic ones (neuroses), I cite them because of their interest as authentic extra-laboratory examples.

IV. ACUTE OR FOCAL DISTURBANCES OF BEHAVIOR ARTIFICIALLY PRODUCED

In contrast to the traumatic neuroses and those arising from natural em[illegible] shocks are disturbances which we see as a result of either 1) tension betw[illegible] born reflex centers (functions, urges, drives), or 2) certain modifications of [illegible] experiments begun under the rigid experimental environment of the labora[illegible] the modifications may involve either order or intensity of the csi or the seq[illegible] of th csi and USi as described in Chapter II. The space devoted to the descrip[illegible] of these various situations is determined by the amount of factual laboratory m[illegible] rial available rather than by the importance of the situation in ordinary life.

While any of the following methods may eventually result in a chronic [illegible] turbance in susceptible dogs, in even the most stable dogs at least a temporary [illegible] results. On account of their universality as etiological causes of acute disturba[illegible] I discuss these methods here in this category though it should be remembered [illegible] chronic disturbances ("neuroses") may sometimes follow.

Some of the symptoms described in the present chapter represent phases [illegible] development of a stereotyped, chronic neurosis. But it is not always true th[illegible] animal goes through the acute stage as described below in developing a chr[illegible] neurosis, any more than it is true that in evolution a species has passed thro[illegible] all the preceding lower forms of life that we know. Certain animals show [illegible] symptoms for only a day or two and then recover, others pass through the [illegible] phase to a more serious and widespread involvement.

1. Conflict Between Two Centers of Activity or Drives (URs)

Experiments based on a conflict between emotional drives were performe[illegible] Pavlov's laboratory by Yerofeyeva and by Konradi and Rikman. The former [illegible] vestigator in 1913 using a pain stimulus—a faradic shock to the skin—as a c[illegible] food was able to transform this natural unconditional pain stimulus into appare[illegible] a pure food cs. However in spite of the fact that for a certain length of time [illegible] animal gave only the food reaction to the painful skin stimulus, later it passed [illegible] an inhibitory and disturbed state during which all the other food crs were s[illegible] pressed.

About 1927 Konradi and Rikman performed the following experiments u[illegible] three UR "centers" or drives—two defense and the third food (*89*). One t[illegible] was made the signal for the introduction of acid into the mouth (salivary def[illegible] reflex), another tone an electric shock to the paw (motor defense reflex), a[illegible] third tone a signal for food. The shock was sufficiently strong to produce ma[illegible] defense reactions—tearing off apparatus, yelping, falling off the table, and li[illegible]

the motor defense reflex alone was evoked by any of the three tones with the suppression of the acid and food reflexes. By discontinuing working with the acid and the defense reflexes and reinforcing all the tones with the food reflex the behavior of the animal became quiet for several weeks, but after some months a pathological state set in. At this time the animal "fell into the hypnotic state, the equivocal or paradoxical phase ensued, and after feeding the defense reflex returned." Pavlov points to the analogy of clinical cases (war neuroses) in which traces of strong past experiences come out during hypnosis, giving as an explanation the retention in the subcortical centers of the past severe excitation with disorganization if there is weakened inhibitory action of the cortex or of the subcortex or if positive induction acts between the cortex and subcortex.

The procedures adopted by Maier (*79*) in rats and Masserman (*83*) in cats are chiefly in the nature of conflict between two different centers (drives), viz., between the excitation of food and of pain (fear of air blast).

A human patient suggesting a parallel to the animal conflict between defense and food unconditional reflexes has been observed in the Pediatric Clinic of the Johns Hopkins Hospital. An infant when two weeks old developed an esophageal stricture or obstruction for which a gastrostomy was performed. All the feeding was done via the stomach fistula until the age of 20 months. The obstruction was relieved shortly before this and feeding given through a nasal tube. Attempts to feed the child by mouth met with aggression and refusal for 3 to 4 months and have continued till the present though the child is two years old and though the tube is well tolerated. There was apparently set up here at an early age a conflict between two URs, defense and food, in which the defense reactions have become a cs for food, which is accepted only in the presence of the usual defense cs. It is quite possible too that lack of reenforcement of the natural conditional stimuli in oral feeding (after the first two weeks of life, when the child ate through the mouth) has resulted in a loss of weakening of the food crs necessary for taking food. The natural food csi have now become, from lack of reenforcement, inhibitory, leading to refusal; and, on the other hand, the US for defense is the food cs for nutriment introduced through the tube.

The part played by the qualities of food acting as csi can be easily seen from experiments with puppies to whom no meat was ever given till they were adults; they refused meat and could only with difficulty be taught to eat it. Stefansson, the Arctic explorer, related to me how his Eskimo dogs would almost starve before they would accept beef, fish or any food that they had not eaten as puppies; he was forced to supply them with polar bear, seal, wolf and other northern flesh. I have noticed in my own dogs that even the killers will never touch the flesh of other dogs.[1]

[1] On the other hand the selective feeding experiments of C. P. Richter on rats do show a universal

In the above examples two strong subcortical centers were excited simultaneously or in the same setting by food or destructive (pain) stimuli.

Under natural conditions an apparently similar situation (food vs. pain) exists when the animal goes forth to fight for and kill its prey; but it does not become neurotic. It is not possible to analyze the difference between the two situations from the experimental point of view but the following may be pointed out. When the animal attacks for the purpose of obtaining food it is hungry; the motivation for food (tension in the food "center" according to Pavlov) is powerful and furthermore the defense reflexes are of an active aggressive type with free and uninhibited expression in contrast to the laboratory situation involving passive, restrained, and usually unsuccessful defense. Frustration is present consistently and repeatedly in one situation but not in the other. The influence of the human being in the laboratory experiment is undeniable and will be analyzed in a subsequent chapter. It may be a factor that deserves more attention than has been given it.

The excitation of *any* two URs simultaneously does not necessarily result in conflict; this can be seen in the ordinary affairs of life as well as in the following experiments. The orienting or investigatory reflex is an unconditional reflex[2] present with all new or strange stimuli; the result is the turn of the animal toward the source of the stimulus. This reflex frequently persists in some dogs in the laboratory experiments even after hundreds of repetitions of the conditional stimulus though after a few seconds it is followed by the appropriate food or defense conditional reflex. The persistance of the orienting reflex seems to indicate a disturbance in an animal with a weak nervous system, but I have never noticed any breakdown resulting from the coincidence of the orienting reflex coinciding with either food or the defense unconditional reflexes.

In several dogs in our laboratory sexual URs have been elicited. The orienting reflex has never been seen to be in conflict with the sexual reflexes. Reciprocal relations have been noted in one of our pathological animals, Nick, between sexual reflexes and anxiety producing stimuli, but these have not been in the nature of a conflict.

The failure of the conflict here could well be attributed to the weak character of the orienting reflex in comparison with the food, defense and sexual reflexes or to the biological nature of the orienting reflex as a coordinating, allied reflex. In the detailed account of Nick, these factors will be further analyzed.

and undeniable tendency of the organism to supply biological needs; the complexity of the problem does not belong to the present discussion.

[2] It fulfills several criteria: it is seen at an early age, is independent of experience, and is present in decorticated dogs. However, unlike most other unconditional reflexes it may quickly be extinguished in some dogs.

Thus it can not be stated as a general principle that simultaneous excitation of two URs results in conflict, nor even that the defense and food reflexes as they may occur together under natural conditions, lead to a breakdown. As pointed out above, there is likely some additional element inherent in the laboratory situation, perhaps in the nature of frustration, or perhaps in the special function (teleology) of the orienting reflex. The difficulty of an explanation based wholly on "meaning" or teleology is that it cannot be relied upon for an explanation, for the animal as often appears meaningless as "meaningful." That phenomena proceed in a definite order is incontrovertible as is also the fact that when the order is perceived either by external or by internal observation (introspection) it can be rationalized and given a convenient meaning. If from such a concept of meaning a prediction is possible then it is useful. But neither in nature (as we have already recognized) nor in biology is it true as Candide had to learn the hard way *"que tout est necessairement pour le meilleure fin dans ce meilleur des mondes possibles."*

Whatever the explanation the fact is indisputable.

On the other hand the conflicts between sexual drives and other impulses are not only recognized as the most frequent causes of imbalance in human society, but animal observations point to the same fact. The dominating role of the sexual reflexes is too well known to need amplification. To mention a single instance within my own experience—an otherwise docile bull who does not venture beyond a low wire fence to obtain food, will attempt to jump or break the strongest enclosure or even brave the hazard of an electric fence to get to a cow in estrus. The following experiments from one of our stable dogs (Vesal) and another labile one shows the imbalance in the crs concurrent with being placed next to a dog in estrus:

TABLE 5

Disturbance Produced by Proximity of Males to Female in Estrus

Dog	Date		Control		With Dog in Estrus	
			+cr	−cr	+cr	−cr
Vesal	9 Feb.–17 Feb. 1942		100	0		
	18, 19, 20 Feb. 1942 21 Feb. 1942		100	0	90	50
Bamech	Nov. 1942	Bu (strong cs)	110		Bu 40	(reversal normal relations)
		M20 (weak cs)	30		M20 120	

Two other male dogs in October 1942 when placed in a paddock with a dog in estrus were so disturbed when brought down to the experimental camera that it was impossible to work with them for about a week; the crs were abolished or

they became paradoxical, i.e., the weaker ones gave a larger effect th stronger (experiments of Dr. Dworkin, already cited in Chapter III).

In the discussion of acute disturbances are omitted situations described by P lov as external inhibition, or what we might ordinarily call distraction, be such an (unlearned) disturbance occurs apparently without conflict or tens the nervous system, in contrast to the situations involving internal or "lea inhibition.

The process of simply forming the positive and negative crs in dogs invo some disturbance of behavior. The animal passes through stages of adaptatio the new environment with more or less upset, finally reaching a stage of equ rium with appropriate reactions to each cs provided, first, the problem is no difficult, and, second, the individual is a capable type. This disturbance is rea detectable in an analysis of the heart rates as will be pointed out in a later chap

The USi most frequently used for the investigations of the crs of dogs are food or 2) pain, because of their biological importance as well as the ease of me uring and recording some component of the reaction to these stimuli. Another added recently by the author as a basis for forming crs is the sexual reflex interest as a comparative study and for special studies. Food and pain howe remain the most useful in the ordinary laboratory study of general behavior.

In the work with dogs the disturbances of behavior are much more rea established using food as the US than those using the kind of pain we empl Direct physical pain as applied in the laboratory to both dogs and human subje rarely gives rise to those marked disturbances of behavior occurring in the dog an effect of conflict based on food excitation. But *pain plus emotional* shock m produce severe upsets as pointed out in the chapter on traumatic neuroses.

It is probable that a greater disturbance of behavior is caused by eliciting t *defense and food* reflexes simultaneously than by using the pain stimuli alo we seldom see in our dogs in which we elaborate only defense reflexes the mark disturbances that occur when both defense and food reflexes are employed in t same setting.

These disturbances may be only acute or they may become fixed and chro

From all these considerations it is improbable that the excitation of two centers and drives is responsible for conflict (as originally thought by Pavl unless they are especially opposed to each other. That the mechanism and t explanations are not so simple as it seemed to Pavlov is evident from the fo going examples. The whole problem requires further elucidation.

The question of what determines the intensity of the various emotional dri is of much greater importance in ordinary life than in these laboratory experim

[3] E.g., the pain of operations, as well as of the severe convulsions of shock therapy.

for the reason that we usually work with only one or two different emotional states (food or pain) and that in normal animals the degree of emotional tension is controlled by the controlled intensity of hunger or the regulated intensity of painful stimuli. The maintenance of these tensions or states is essential for the production not only of neuroses but even of the normal cr. For example all the food salivary crs fall to zero when the dog is satiated, as well as the cardiac crs dependent upon the food (*38*).

2. Conflict of Conditional Excitation and Inhibition

see [illegible]

In the routine training of dogs for the laboratory work with crs, the animal is put into the experimental camera about two or three weeks after making the salivary fistula, and fed there for a few minutes to an hour daily with intervals between feedings increasing from a fraction of a minute to several minutes. When he becomes quiet in the camera alone, without any one standing by him (as one does in the early period of experimentation), the salivary disc is applied, then the door is closed, and the cs is given 5 to 30 seconds before the food. After establishing a single stable positive cr, a period requiring one to several weeks or months, others may be added or a negative inhibitory cr established by introducing a cs unaccompanied by food. The negative cs, resembling as it does the positive, elicits positive motor and secretory responses at first but these gradually (after days or months) disappear. Differentiation by *analysis* has then occurred in addition to the *synthesis* when the animal forms the positive cr.

The procedure using painful, or in the objective terminology of Pavlov, destructive stimuli, is essentially the same except that the process is usually shortened, requiring only weeks instead of months. If we compare the motor with the salivary component of the food cr it is seen that the former is established much more quickly.[4] There is thus a marked difference in the expression through the skeletal musculature, controlled by the central nervous system, and through the secretory and possibly smooth muscle reactions, mediated through the autonomic nervous system. Furthermore the cardiac and respiratory crs differ from both the ordinary motor and the other autonomic cs.

In the routine work by the above methods with dogs chosen for general problems of the laboratory, those animals who are too unruly and do not adapt well to the environment are usually discarded. For this reason we have a selected group

[4] The shorter time for elaboration of the motor component of the food cr or for the motor defense cr, may be due to 1) the difference between the "learning" ability of the autonomic and of the central nervous system, and 2) to the method of measurement, viz., the stability of the secretory cr is measured quantitatively, while stability of motor cr is ordinarily a qualitative measure and much cruder—whether or not the movement appears.

of animals in our ordinary researches and therefore probably see fewer neu-
than we would if we studied the whole canine population.

Our procedure in the training of the dogs is essentially the same as that in Pavlov's laboratory except that we restrain the animal less, having only a collar about his neck to which a leash is fastened. He stands on a low table or directly on the floor. In the Russian laboratories the dogs are frequently supported by a harness under the fore and hind legs, and placed upon a high table, a proced- which at first adds to the disquietude of the dog.

not

The training may be roughly likened to that of education except that in addi-tion to a certain amount of restraint, the conditions in the laboratory are rig- controlled and measured quantitatively in respect to the intensity of motiva- (US) and of reaction (both UR and cr).

In working with the food conditional reflex the disturbances consequent up- the restraint in the laboratory environment are gradually overcome and repla- by the appropriate food excitation. Because the dog has become quiet and gener- well adapted to the laboratory environment before we begin any problem invo-ing our artificial inhibition (differentiation, extinction, or delayed crs), the dis-turbances in behavior which follow the introduction of inhibition can be refer- in my opinion, more particularly to the balance between excitation and inhibi- than to the restraint of the laboratory, although restraint *per se* may have def- disturbing effects as shown in shifting some of my dogs from the country to t- city. But the laboratory inhibition of the specific inhibitory crs is operative in addi-tion to the restraint and separate from the restraint. This point deserves empha- because Maier and others have considered that the essence of the Pavlovian e-periment may be restraint of the animal.

not

One great advantage of using the cr method for producing nervous disturban- in dogs is that we can see its development at every step and reproduce it when choose. It is perhaps of greater interest to know that *exact moment* and situat- under which a disturbance begins, and to understand *how* it spreads, than to b- hold the full-fledged neurosis. We may thus see the incipient stages rather tha- state of terminal psychopathology—something that we are unable to do in t- clinic. In order to trace the disturbance resulting from the introduction of artific-

TABLE 6
KOMPA 15 DEC. 1930
BEFORE CONFLICT

14:23	M60(+) = 100
14:30	M144(−) = 30
14:37	B_1(+) = 75
14:53	M60(+) = 125
14:58	B_1(+) = 110
15:03	M144(−) = 8
15:22	Tactile Stim. = 130

inhibition from the very beginning, the following protocols from one of our first dogs[5] are submitted (Tables 6, 7).

TABLE 7
KOMPA 2 JAN. 1931
EFFECT OF CONFLICT

9:39	M60(+)	= 100 } opposite stimuli given
9:44	*M144*(−)	= 160 } too close together
9:49	B_1(+)	= 160
9:54	Tactile Stim.	= 40
9:59	Bu	= 30
10:30	L60(+)	= 0
10:34	M60(+)	= 3
10:44	M60(+)	= 9
10:49	B_1(+)	= 40
10:54	Tactile Stim.	= 10

A description of this animal was given previously in recounting the effect of the natural emotional upset on dogs (Ch. III) and the effect of alcohol on various types (*30*). She had been used in the laboratory since April 1930. The protocol (Table 6) for 15 December, 1931 shows the normal relations and reactions to the positive conditional stimuli and to the negative inhibitory one, M144. The latter normally produced sleep within 7 to 9 seconds after it was first started.

TABLE 8
KOMPA 15 JAN. 1931

14:50	B_1(+)	= 190
15:07	*M144*(−)	= 100
15:14	Bu(+)	= 40
15:18	M60(+)	= 85
15:23	B_1(+)	= 120
15:28	*M144*(−)	= 65
15:33	L(+)	= 5
15:40	Tactile Stim.	= 100
15:46	L(+)	= 80
15:50	*M144*(−)	= 95
15:55	L(+)	= 5
16:00	Tactile Stim.	= 35
16:05	B_1(+)	= 95

Protocol 2 (Table 7) shows the result of giving M60 and M144, positive and negative csi, next to each other. The dog was more susceptible at this time than three weeks earlier on 15 December because she had *puppies* on 29 December which caused a temporary (for a few days) loss or imbalance of the crs. On 2 January M60 given at the beginning of the experiment is normal in size, but after M144 all the crs are decreased, and M60 in the seventh position at 10:34 gives only three scale divisions compared with 100 at 9:39. Ten minutes later at 10:44 M60 has recovered its strength somewhat. It is noteworthy on this day

[5] These experiments were performed by Harold G. Wolff and Gantt.

that there was poor differentiation between M60 and M144, and this la ability to differentiate on that day may be considered as the cause of the flict.

On 15 January, 1931 inhibition to M144 is better than on 2 January, th not so good as on 15 December. On 15 December M144 gave a secretion f seconds of thirty and eight for the two trials; on 2 January, it gave 158, an 15 January, 99 and 67 (perfect inhibition would be 0 secretion).

In Protocol 3 (Table 8) there is clearly seen again the effect of introduci poorly differentiated cs on the subsequent crs. This is evident even on 15 De ber when differentiation was fairly good. Bell coming next to M144 and 7 min afterwards gives a secretion of 75 compared to 110 when it comes in the position 28 minutes after M144. M144, still poorly differentiated, has a mode effect on the strong auditory csi which follow it but a much more pronounced ef on the weaker and newer visual cs, L (light). When L follows M144 in 5 min at 15:33 its value is down to 5, and 18 minutes after M144 at 15:46 its valu 78. Exactly the same thing is seen when M144 is applied the third time at 15: L coming 5 minutes later is again duced to 5 (fig. 7a).

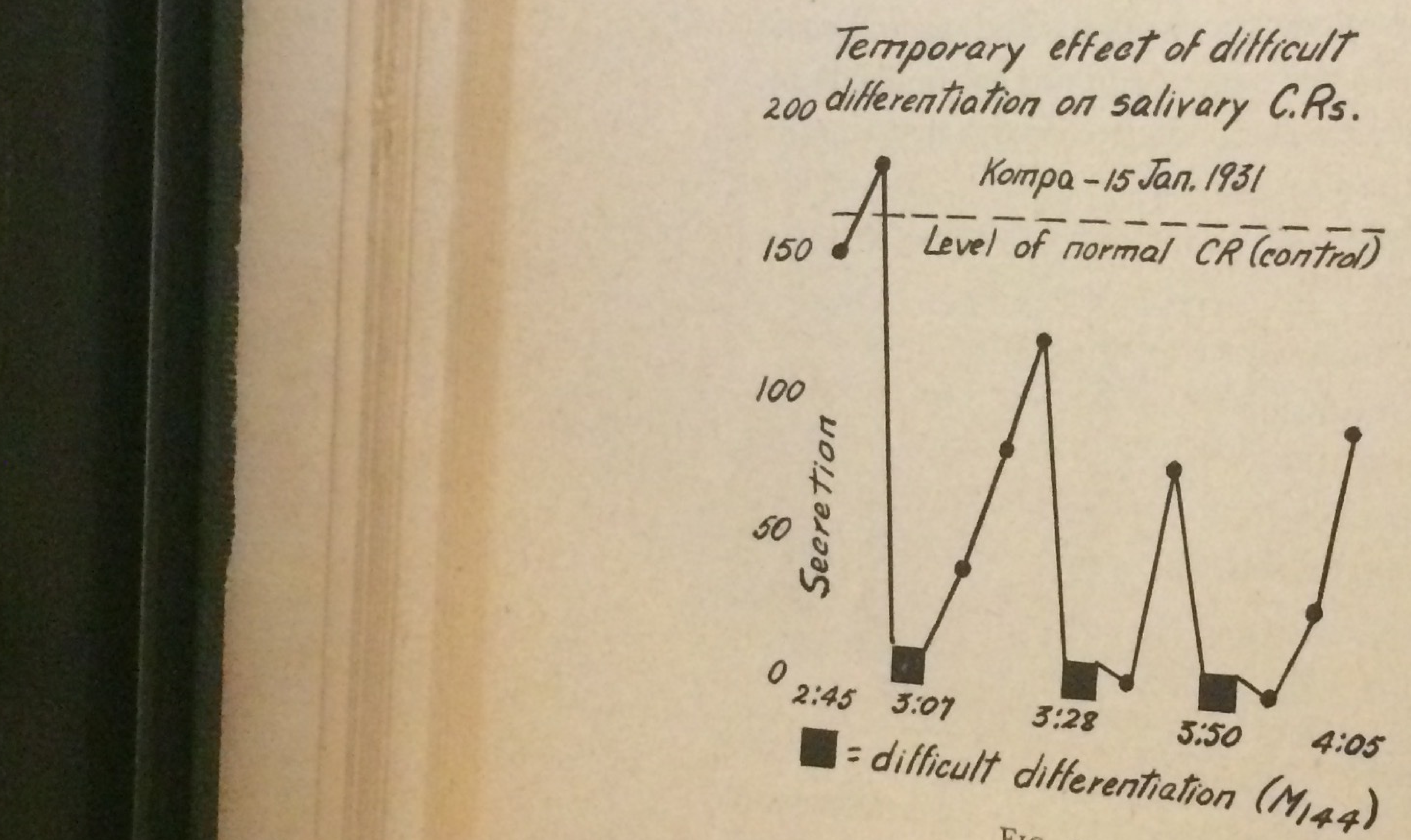


FIG. 7a

On 30 January the positive crs are normal intensity and the inhibitory c M144 is nearly perfect (with no sec tion for 10 seconds and only 13 for minute). B gives 90 and 130, and which was down in the experiment of January to 9 just after M144, is n 110. But when M60, which had not be used for several days, is introduced, differentiation of it from M144 is po shown by the secretion of only 3 inste of a normal value of about 100, and t effect on the behavior is seen at once well as on the subsequent days. The a mal does not eat the food on the ne stimulus, and on 31 January the disturbance is even more marked, as reflec both in the cr readings and in the general behavior. Differentiation to M144 impaired; instead of zero it gives for 60 seconds 113 the first time, 84 the seco and 292 the third time. Differentiation between M144 and M60 is practica lost; the values of the 10 second secretion to M60 is approximately the same to M144 for an equal period.

The behavior of the animal runs parallel to its ability to differentiate. On February differentiation to M144 is complete: there is little or no secretion to

even though M60 is given repeatedly. Sleep appears within a few seconds after M144, and lasts during M144 and sometimes until the next cs. Restlessness and dyspnea have entirely disappeared. It is thus clear that by proper intervals between the csi (M60 and M144) and with continued practice this animal can handle the situation giving the appropriate secretion to each; she is quiet and without the nervous symptoms that we saw at the onset when M60 and M144 were given too close together in time before they had been differentiated.

These experiments are given in detail to show just how and where the breakdown begins. This animal was an excitatory and moderately labile type, as seen in these and various other experiments. From our knowledge of other animals we can state with assurance that, in a dog of this type, if the differentiation had been pushed[6] beyond the animal's capacity instead of in adjustment to its ability, a permanent breakdown such as we shall see in Nick would have resulted.

These exact and reproducible quantitative relations are a striking example of the applicability of the salivary cr method in the study of behavior. It affords us a quantitative measure for the difficulty confronting the animal before it is apparent in the behavior. By any other technic it would be difficult to detect the exact point at which pathological relations begin and to record them quantitatively. Moreover the observable gross abnormal behavior is more uncertain and often more difficult both to observe and to evaluate. Needless to say, the behavior is important as it alone is ultimately the criterion of the disturbance.

A comparable disturbance can be seen in the effect of a difficult differentiation on the motor defense crs, although the results can not be recorded in the same quantitative way. Thus in a stable animal, Connie, who had learned to differentiate perfectly between M92 (+) and M100 (—), when a closer differentiation between M96 (+) and M100 (—) was introduced, the result was a disturbance of even a simpler and an easier differentiation (M80 and M100) which was previously firmly established, without immediate disturbance in the behavior (fig. 7b).

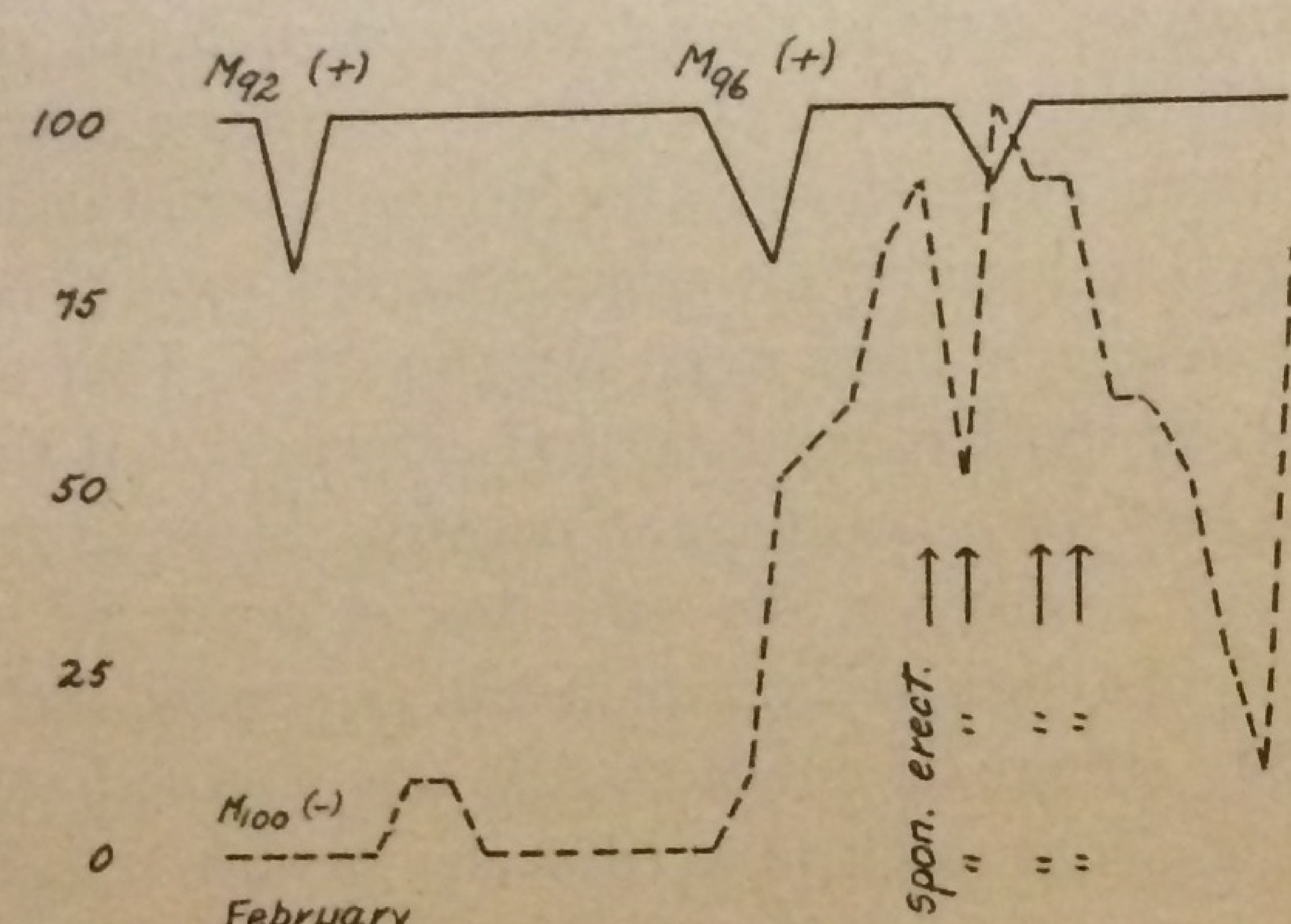


FIG. 7b. Concurrenct of spontaneous sexual erections with difficult differentiation in dog C caused by changing M92 (+) to M96 (—).

[6] By "pushing" is meant repeatedly giving M60 and M144 close together or even at 5 minute intervals if they are not separated by a differentiated and non-conflicting conditioned stimulus, i.e., one not closely resembling physically the non-differentiated pair.

Even in this stable dog some weeks were necessary before the animal gave the correct cr to two metronomes which had previously been easily dif- tiated. Moreover, during this period of difficult differentiation the animal to show other signs of disturbance in behavior, i.e., in the autonomic system appearance of spontaneous sexual erections when put into the camera and changed relations in the cr heart rates).[7]

Whether or not the animal would suffer a chronic disturbance from such a flict of csi is also dependent upon the individual "constitution," as we see later. Some animals even though pushed with the conflicting stimuli w never show more than a limited disturbance, without spread to the general a ity.

The above described examples show the burden imposed upon the nerv system by a differentiation confronting the animal for the first time, in the pro of elaborating crs. Likewise with well established crs we may have a confli space or time.

The term conflict is based upon the concept, for which there is some evide that excitation and inhibition are mutually exclusive processes. When we b them close together in space the excitations must enter through the same analyz and resemble each other in their physical properties so that they lead to clo adjacent cortical areas. A conflict in space refers to the nature of the positive a negative csi, e.g., all metronomes of near M60 frequency stimulate closely ly receptor areas of the nervous system, or, if on the other hand, the same area the brain is stimulated but the response is not the same—a "conflict in spa occurs. Even though they are not given together, and perhaps are separated days or months, their corresponding cortical regions may be supposed to over so that one flows over into the other. That this view rests upon facts has be shown by Pavlov in cortical extirpations of the skin analyzer. A conflict in ti occurs when positive and negative csi are given simultaneously; e.g., when M (+) is given at the same time or separated by a very short interval of seco from a negative light or tactile cs, stimuli which come in over different recept The stimuli do not necessarily resemble each other physically nor stimulate clos lying receptor areas as M60 and M70 would, but there is a conflict in the termi or executor end only in that they lead to mutually exclusive responses. Furt investigations on the nature of the nervous conflict may give us a basis for m satisfactory descriptive terms than "conflict in space or time"; the argument f their present use is that they are short and related to the experimental concept conflict.

Most of the laboratory disturbances are produced by this method. Fritz, Pe and Nick are examples; they will be described in the next chapter.

[7] These phenomena will be discussed subsequently under tht system changes.
[8] "Analyzer" is Pavlov's term for receptor system including the central brain portion.

3. Changes in the Established Routine

Although many of the situations under which a nervous breakdown occurs might be considered as changes in the established routine, I shall discuss in this section only those causative factors (especially those relating to the artificial crs) that seem to fall more naturally into this class than into the other groups.

Experiments showing that the dog adapts not only to the individual conditioned stimuli but to the order in which conditioned reflexes of varying intensity are given irrespective of the time element were performed by Gantt (*41*) in 1931 and by Kupalov (*89*, p. 99) in 1933. The adaptation to such an order of varying intensity is described by Pavlov (*89*) under the term "dynamic stereotypy."

In four dogs I used alternately large and small csi the sizes of which were determined by the amount of food reinforcing the conditional stimulus. The arrangement adopted here was one of the simplest conceivable—the regular alternation of two stimuli of different intensities. After many repetitions of the stimuli in the order *strong-weak-strong-weak* it was found that when one of the stimuli was repeated alone throughout the experiment, e.g., *strong-strong-strong-strong*, its value was dependent upon the relation of its position to the previously established order.

If the sequence was made more complicated and if no definite time relations were used to facilitate the establishment to the order, it was found that the value of the cs alone, rather than its position in the order of the experiment determined the intensity of the reaction. Kupalov, instead of using two positive crs of unequal intensity, adapted his dog to a simple alternation of excitatory and inhibitory csi.

Although adaptation is readily made to a *simple* order, I found that not only was it impossible to adapt accurately to a *complicated* order but that any adaptation was dependent upon the intelligence of the individual animal. A dog with part of its frontal, parietal, and occipital lobes removed on one side, although it could still elaborate positive and negative crs, showed no adaptation to the order in which they were given.

Although the adaptation to an established order is a powerful aid in the stability of the crs, on the other hand a change in such order may result in severe nervous disturbances lasting perhaps for months. One animal, in which a new stimulus was introduced into an established system of positive and negative csi, became extremely restless, struggling, barking, tearing off apparatus, with loss of positive conditional stimuli, refusal of food, and resistance to being brought into the experimental camera. This nervous disturbance lasted for 3 months. The animal returned to normal and the problem was simplified by reducing the number of inhibitory csi. Another detailed example is given in Chapter IV in our dog Kompa. On the basis of a conflict between the crs to the old and new patterns this is no more difficult to understand than is the production of a neurosis by a conflict between excitatory and inhibitory crs.

The human being also offers great resistance simply to a change of ex
routine if the change is superimposed *from the outside*. The fact that certa
viduals do not conform well to the discipline of an imposed routine is in
contradictory to the general tendency of everyone to resist a change tha
from the outside rather than as a result of internal rhythms and adaptatio
conformity to an imposed routine may well involve conflicts between exter
internal rhythms, if there are a large number (*41*, *95*).

4. Change of Intensity of the Conditional Reflex

Before discussing the perverted relations, as measured by the crs, of the in
of various conditional reflexes, it is necessary to say something about the n
intensities. The size, strength or intensity of the conditional reflex depend
several factors.

1. I have established the fact that the intensity of the cr, i.e., the amou
secretion, varies exponentially with the unconditional stimulus, i.e., the a
of food, as mentioned in Chapter I (*37*).

2. In the early part of Pavlov's work it appeared that the intensity of t
was related specifically to the analyzer of the cs. Olfactory and auditory c
tional stimuli were most powerful, next came the visual and the tactile, and fi
the thermal. Later it appeared that this hierarchy was not unalterable, f
ample, a very strong light produced a larger cr than a very faint tone (
3. Within any given analyzer the cr is proportional to the strength of t
(as well as to the US) but only within certain limits. If the cs is too strong i
produce no greater effect than a weaker one, but on the contrary may give
gressively decreased effect. This is what Pavlov calls ultramaximal st
tion (*89*).

Conversely, the relation of intensities of the crs initiated through the diff
receptors may serve as a measure for the disturbed cortical function. Pavlo
scribes several phases through which the animal may pass—representing va
degrees of disturbance of equilibrium between excitation and inhibition (8
347, 355, 366). First, the phase of *equalization* in which all the crs are o
same intensity; second, the *paradoxical* phase in which the weak csi alone g
positive effect and the strong csi become inhibitory; third, the *ultrapara*
phase, during which all the crs to the usual positive csi drop out while, o
other hand, inhibitory stimuli give a positive effect; finally, the *inhibitory*
in which there are no positive crs. After this various pathological states su
e.g., hypnosis, catalepsy. These have been fully described by Pavlov.

The appearance of the above phases may be used as measures of a disturbed
librium resulting from various causes, traumatic, etc., as I have shown in Ch
III and elsewhere in this book. Such changed relations in the crs are much

delicate barometers of equilibrium than are the overt motility aberrations or ordinary observations of behavior. (See Chapter I and elsewhere in this book.)

5. Change in Relation between Conditional and Unconditional Reflexes: Lack of Reinforcement of Conditional Reflexes by the Unconditional Stimulus

Another type of change in the daily routine or pattern of the crs that may result in psychopathology is the failure to follow the cr by the usual US. A restless, agitated condition of the animal, either acute or chronic, may result. On the other hand, when the US routinely follows the cr, the animal is quiescent. There is a "refractory" period during which it is non-reactive to similar csi; but where the US does not follow, i.e., reinforce, the cr, the activity continues for some minutes or longer during the interval period when the animal should be at rest.[9]

This principle was accidentally discovered in the establishment of crs of different intensities by using a large and a small amount of food to produce a strong and a weak cr. The intensity of the cr was shown in these experiments to be logarithmically proportional to the amount of food used for reinforcement (*37*). Four dogs were used; in one pair, M20 was given as the conditional stimulus for 18 gms. and another auditory stimulus (air bubbling through water—Bu) was the signal (cs) for 3 gms. of food. In the second pair of dogs, in order to counteract the effect which each stimulus might have *per se*,[10] without reference to the accompanying food, on the size of the conditional reflex, the signals were reversed so that Bu was given with the large amount of food and M20 with the small.

Routinely the cs is given for 10″ before feeding and continued for 5″ after the animal begins eating; the cr is measured during the 10″ period; and the UR is *measured for 60″* from the time that the animal takes the food (practically from the moment the food is dropped in the box in front of the dog); as a rule, all the UR secretion is over however in 30″ to 40″, there being no more secretion until another cs is given. The length of the time required for the animal to eat 18 gms. of food is usually 5 to 20 seconds less than the period of the UR secretion (*37*). For the purposes of more accurate measurement the signal is given once daily for 30 seconds instead of the usual 10 seconds before food and the total quantity of cr secretion measured for 30 seconds. The UR is observed for a period of 60 seconds after eating begins although it is usually complete in 30 to 40 seconds. With 18 gms. of food, chewing lasts for 10-25 seconds depending upon the individual.

[9] This phenomenon was described by the author at the meeting of the American Psychopathic Association in 1932 under the title "A New Law of Inhibition; Inhibition of the Conditional Reflex by the Unconditional Reflex." As this paper has not yet been published in detail, the evidence for the law will be briefly described.

[10] Conditional reflexes vary in intensity according to the strength of the conditional stimulus as well as to the analyzer through which they come as mentioned previously.

The URs were also not directly proportional to the amount of food (1 were in the ratio (2:6). It occurred to me that possibly the reason why th were not directly proportional was because their true values might be ob by the effect of the cr on the subsequent secretion. We know that a sign food may cause a secretion that lasts 60 seconds or more and it seemed to suppose that this cr would run concurrently with the UR and add itsel i.e., show up in the 60 second period after eating begins.

This hypothesis was tested in the following way:

1. Measuring the secretion of saliva to the 3 grams and to the 18 grams of when eating was not preceded by the usual cs. This would not rule out how the influence of the natural conditional reflexes, i.e., to the sight and odor, etc the food, operative for the fraction of a second between the time the food and when he begins eating. 2. Letting the cs run for a minute *after the an begins eating* and comparing the total secretion for the minute with the am obtained in the usual manner where the cs continues only 5 seconds after beginning of eating. If the cs has an effect it should increase the amount of s for the total minute after the animal begins eating. 3. Comparing the curve cr and UR secretion when they occur separately with the curve when they co cide. 4. Preceding the large amount of food by the signal for the small am and vice versa. If the cr continues during the UR then the latter should app smaller when it follows a small cs and larger when it follows a large cs. 5. P ceding the US by an inhibitory stimulus, i.e., a signal which means "no food" the animal. This is a variation of the foregoing instance. If the cr is added in the UR the latter should be smaller when it follows a negative stimulus (the p sible role of induction has not been considered). 6. Comparing the curve of UR to food with that to acid when the former has been preceded by a cs for and, contrariwise, when acid is preceded by a food cs. If the URs are affected the crs the curve of the cr should modify that of the UR.

note

Contrary to my hypothesis, I found that the UR in all the above instances remarkably constant and apparently unaffected by the cs (signal) that preceded

About the same time Beritov (5) found that if the cs for a shock was repe within a short interval of a previous shock there was no response to the conditi stimulus. Beritov's and my experiments were done and published independe and without the knowledge one of the other; furthermore mine concerns the se tory food system and Beritov's the motor defense. They are therefore strong confirmatory of the same basic law in more than one type of excitation.

Hence I conclude that the cr normally ceases its action the moment that the U

[11] Later I found that the unconditional reflex for a given food is nearly proportional to the le of time required for the animal to eat the given quantity of food. Thus the animal eats the 3 gr say 4 seconds and the 18 grams in 12 seconds.

begins, i.e., when the dog starts eating. But if the UR does not follow it at the usual time (the end of 10 seconds), the cr continues for a minute or more; hence one must conclude that the cr is cut short by the presence of food in the mouth, i.e., the US. The weaker, acquired, cortical reflexes to the distant signals (sound, sight of the food) give way, become checked by the more urgent, inborn, subcortical reflexes to the contact of food with the oral mucous membrane.

Summation is found both among allied (cortical) crs to signals, under certain circumstances, and also among allied segmental reflexes. In order for summation of crs to occur, they must not be maximal. If segmental reflexes are antagonistic instead of supplementary, see Sherrington's principle of the final common path, where one gains the right of way to the exclusion of the other. It appears that the relation of the cortical activity (cr) to its subcortical reflex (UR) obeys the same sort of law—as if the cr and UR were antagonistic instead of allied.

The implications of this law are many and important. Let us see what happens to a dog when the cs is not followed by the appropriate US. Suppose the animal has been trained to get the food 10 seconds after the signal begins: an activity of the animal's muscular and glandular systems is evident, increasing in intensity until the food is obtained, after a latent period of 1 to 6 seconds. Following the eating of the food the dog is quiescent until the next stimulus. But what is the chain of events when the food is not given after the cs? The activity directed toward the food increases for about 30 seconds, then the secretion gradually diminishes for a period of another 30-40 seconds, and the animal becomes restless, agitated, barking, whining, sometimes jumping about the stand, biting the attachments, trying to escape. If the cs is given only once without food the disturbance is not marked, but if given often one of several things may happen: the dog may pass again into a state of quiescence or sleep accompanying extinction, or into one of chronic agitation. In both instances cr secretion is usually though not always absent.

The element of time is not important; it is the variation of the time from the adopted procedure. For example we may elaborate a delayed cr in which the food is not administered until 3 minutes after the signal. During this period, the animal is quiescent and there is generally no secretion until the last 5 to 15 seconds before the food is accustomed to come.

In the chronically agitated animal where there is great restlessness but no secretion and even turning away from the food the same as in the defense reaction to pain, we may think that the cortical response has become permanently cut off from the appropriate subcortical reflex and diverted into other subcortical paths (defense) and diffused as a kind of general cortical excitability. However, this theory requires much more work for its verification.

When the cs is allowed to continue during the eating and even for 60 seconds

after the eating, one might think that this prolonged stimulus would pro secretion again. However, the quiescent state (rest) initiated by the action of US supervenes so that there is no reaction or secretion observable to the refractory period (at least for the specific cs) ensues.

Whether this law applies also for other stimuli and other effector organs question that requires investigation. In the measurement of heart rates wh have made, as well as in the report of Miles (*85*), there is some evidence th not conclusive that the acceleration of heart rate accompanying the cr sho sharp drop soon after the US, suggesting that the latter stimulus inhibits the crease in heart rate. Also following sexual excitation there is a long perio nonreactivity or lowered responsiveness in most animals but especially in pathological dog to be described subsequently. In rutting females after copula (unconditional reflex) there is a striking reduction or absence of the sexual act (conditional reflex?). C. M. Brooks has called my attention to the fact that ra after ovulation (which is produced by coitus in these animals) will not copu for a certain period; this non-receptive state is not dependent upon pregna for the animal copulates freely later on during gravidity (*53*).

The explanation of the facts (inhibition of the cr by the US), though res upon a physiological mechanism which ends the act, may perhaps be more quately expressed as a behavioristic or philosophical concept such as has been lined by D. M. Levy (*70*). He points out that the organism tends to perf an act as a unit, which is self-limiting. Physiological mechanisms as urination defecation occur in units, as well as do the higher and more complex form behavior, e.g., battles or the performance of any task.

That the US automatically inhibits its own specific cr preceding it, may re sent the physiological mechanism upon which rests the more general law of act as a unit.

The appearance of restlessness and agitation in the experimental situation w an accustomed US does not follow its cr (e.g., food by bell) furnishes a basis the origin of anxiety. The relation of anxiety by Freud to coitus interruptus, frustration of a sexual nature, is clearly an instance of where the cr activity is followed by the appropriate and complete USi, and the onset of anxiety he closely analogous to the restlessness in the dog for several minutes when the for food does not follow the cs. The existence, however, of such a mechanism b upon food rather than upon sex would seem to extend the concept of anxiety involve other excitations than sexual.

As Whitehorn (*91*) has pointed out, a threat of whipping excites, but the ac whipping releases this excitation. Under Nick's history the beneficial effec giving painful stimuli is shown (Chapter VII). A somewhat similar conce

expressed by the British—"I'd rather be bombarded than bored"—where "bored" includes the anticipation of the act.

Frustration itself is not a sufficient explanation because while this might explain the failure of the food crs and the sexual crs, the motor defense crs are also inhibited by the appropriate US (pain), and in this instance instead of frustration there is relief from a noxious agent. An alternative explanation would be the persistence of a pattern according to the previous training. Although this consideration cannot be denied, the fact that the time elements, such as interval between csi, can be varied widely without destroying the pattern, although the omission of the US does change the pattern, this circumstance would argue for a factor other than pattern unless pattern be considered in a general way. Neither can the significance or meaning of the US be the determinant because, as mentioned above, a minute quantity of food will inhibit a very large cr.

V. CHRONIC DISTURBANCES OF BEHAVIOR AR[TI]FICIALLY PRODUCED: CASE HISTORIES OF THREE DOGS

1. General Procedure and Synopsis

Beginning in 1931 three dogs were put through a training (lasting for sev[eral] years) involving one or more difficult or impossible differentiations between tones. Parallel studies were conducted throughout the life of these animals. All of them showed a disturbance of behavior in the situation of conflict but of vary[ing] degree; in one it was only temporary, in the second it was of longer dura[tion] and more severe, and in the third there was in addition a spread to many ph[ysio]logical systems, suggesting the involvement of the "whole personality" perh[aps] similar to a major psychosis, which continued until 1939. Since then (until 19[..]) a gradual amelioration of most symptoms has occurred, probably due to cer[tain] factors in the treatment, but possibly also to other factors such as age.

In spite of the small number of animals in this study and the fact that each [dog] showed a somewhat different behavior under the same circumstances, a full d[e]scription appears worthwhile because of the mass of accumulated and correla[ted] material on three different dogs, with the evidence of "constitutional" fact[ors]. Furthermore there appeared in one dog a remarkable and clear-cut involvement [of] successive physiological systems, which as it *spread*, could be *traced* from the p[oint] of origin, time and again *reproduced* by reproducing the milieu, and finally *modi[fied]* after years of chronicity. Owing to the appearance of some of the symptoms, par[]ticularly the sexual, in one of our dogs for the first time in the literature, a detai[led] account seems warranted as a starting point for further investigation. Observat[ions] even on single animals carefully made and repeated may give us valuable infor[]mation.

note

Fritz was a police dog of apparently stable constitution, aged about four ye[ars] when brought into the laboratory in 1931. On casual observation he appeared [to] be a quiet, well trained animal of the watch-dog type. Sometimes he snapped [at] strangers who approached, but he was not otherwise aggressive. He was given [the] problems of differentiation, tactile and auditory. The auditory csi were broug[ht] successively closer together until differentiation was impossible as with Nick. T[he] behavior was only slightly disturbed; there was moderate restlessness, some pa[nt]ing, and shifting weight from one foot to the other. Most of the time the ani[mal] was quiet and ate the proffered food readily. All the nervous symptoms co[m]pletely disappeared after a short rest.

me Thirty?

The next dog, *Peter*, was put through a similar regime. Brought into the labo[ratory]

tory in 1931, he appeared to be an active mongrel with the build of a beagle, about four years old. He was playful, though sometimes very irritable especially if touched near his tail. By ordinary observation he seemed moderately excitable. The behavior upset was intermediate between that of Fritz and Nick; it was much more pronounced than in Fritz, often approaching the restlessness and refusal of food seen in Nick. However Peter never showed the spread, the involvement of the other physiological systems ("whole personality") that Nick did; moreover his symptoms were confined to the camera and they disappeared after rest.

Nick was a mongrel male born about 1929 or 1930, weight about 12 kg. He was introduced into the laboratory in early 1931 and kept in the paddocks with the other dogs. For about a year before any work was done on him he was brought into the experimental room for casual observation. Nothing was noted then that impressed one as remarkable; in fact he was selected with Fritz and Peter for laboratory work, as being, according to general appearances, normal. He seemed to be lively and playful, perhaps even more companionable and easy to make friends with than other new dogs.

No careful and detailed examination was made on him prior to experimentation, but it is significant that casually and by the means of ordinary observation he *appeared* normal, as shown by selection for experiments requiring a normal animal. The contrast between the results of casual observation and the subjection to the rigidly controlled and delicate measurements in the routine of the laboratory deserves emphasis. *It is only by the latter method that we can detect the individual which will show a breakdown under stress.* The early symptoms seen in the laboratory situation which gave us a clue to the constitutional instability were in Nick, 1) refusing to eat, 2) the absence or inhibition of the conditional reflex when the differentiation became hard, the slight conditional reflex at first, and the easy setting in of inhibition, 3) the lack of differentiation, 4) the striking increase of muscular activity and restlessness.

It is remarkable in Nick not only that the nervous symptoms have continued for 10 years without repeating the original conflict but that the spread to the urinary and sexual systems did not occur till after 1935, several years after the conflict. That they were related to the conflict is shown by their appearance only in the experimental environment and other relationships to the original stimuli, as will be discussed.

Parallel experiments were done on the dogs (with certain variations as noted in the separate accounts) by Dr. R. B. Loucks for the study of irradiation, and it was in this period that the abnormalities began. Dr. Loucks' carefully controlled and painstaking original experiments from 1931 to 1935 are the basis for the account over that period.

A synopsis of the experimentation follows.

COMPARISON OF FRITZ, PETER, AND NICK

FRITZ

B. about 1926. Male, German Shepherd. Wt. 21 kg.

1931

May: Brought to laboratory. Apparently stable, somewhat aggressive.

Parotid fistula operation.

Experimentation began June with T1130 as positive cs.

Secretory cr first appeared on 13th repetition; constant on 9th day after 30 repetitions.

T1130 used alone till 5 Aug.

No disturbed behavior in early training.

5 Aug.: Differentiated new tone without disturbance.

1932

10 Feb.: Partial deafness produced by destruction internal ear. Dog subsequently used for irradiation of tactile crs till 14 Mar., involving daily work and many differentiations of tactile si.

14 Mar.: Differentiation of 2 pairs of tones, one pair in ascending, other in descending order, viz. T530 and T420. Good differentiation by end June after 900 total repetitions of tones.

9 Apr.: Sexual activity normal.

21 July: Two other tones introduced and well differentiated.

6 Oct.: After 2 months' rest another differentiation of 2 pairs of tones closer together in pitch was tried but too difficult for good differentiation.

Dec.: Some restlessness (panting, shifting) but mostly quiet.

PETER

B. about 1928. Male, Beagle Type. 15 kg.

1931

July: Brought to laboratory. Active, pl and sometimes irritable.

Parotid fistula operation.

cr elaborated to T1130; appeared after trial and continued with some irregul

Quiet except for occasional barking; al ate food in camera.

Aug: Tactile cs introduced; cr formed a 4 repetitions.

Inhibitory tactile csi introduced.

Nov.: cr to the tone became irregular decreased in size from 40 to 10. Bark more pronounced, some aversion to food.

1932

Mar.: Differentiation of two pairs of t in ascending and descending order as in duced in Fritz; good differentiation a 1 month accomplished.

More difficult differentiations introduc pronounced barking.

Peter now entered only with coaxing, quently jumping off the table, barking, wh ing, emitted fecal odor, sometimes refu to eat.

Some differentiation of 2 pairs of tones a 540 and 980 repetitions respectively of positive and negative pairs. Peter now how when salivary disc was applied, shook it and struggled when it was replaced.

NICK

B. about 1929. Male mongrel. Wt. 12 kg. Playful, very active, apparently friendly.

1931

Brought into laboratory in 1931. Kept in paddock with other dogs.

1932

Jan.: Parotid fistula operation. Experimentation began. During preliminary adaptation to C, in first month somewhat restless—climbing, shifting about. Punished by experimenter on 4 Feb. for scratching off salivary disc.

5 Feb.: Refused several feedings. Did not refuse feeding again till 15 Feb. when first artificial stimulus was given (T1130); would not eat unless fed by hand.

16 Feb.: Terribly excited; did not eat till 2 or 3 min. after food was dropped; squealing; but quiet in interval between csi.

cr first appeared on 34th repetition.

In contrast to Peter and Fritz, Nick became very excited at beginning of elaboration of cr.

Mar.: Jerked head away from auditory cs as if avoiding pain.

7 Apr.: Differentiation attempted between a pair of ascending tones (T420-T530) and same tones in descending order (T530-T420). Forms weak secretory cr.

Fritz, Nick and Peter together in same paddock, Nick more retiring than others, especially when dog in estrus was in C.

13 Apr.: Nick began to turn away from food.

After 140 trials differentiation fairly good. In June after 300 repetitions of positive cr and 655 of negative cr, both motor and secretory differentiations.

July: Differentiation made more difficult.

During summer began to develop definite defense reactions, tearing disc from his face.

Aug.: Refused to eat food after positive csi. After rest from 27 Aug. to 10 Oct. Nick again readily ate food in C.

10 Oct.: Still more difficult differentiation introduced; after first day Nick refused food in C and continued to refuse it practically during his whole laboratory life until the present date (end of 1943), in spite of over 10,000 repetitions of cs and food.

Rations cut in half in order to stimulate eating in C; will eat in C only when fed by hand.

FRITZ

1933

Good differentiation accomplished by March.

New tones still closer in pitch introduced; to this nearly impossible situation Fritz became non-reactive, continued to eat when food was dropped but whimpered and was restless (panting, barking, violent yelping or standing motionless).

Normal sexual activity in paddock. Motor cr disappeared but secretory cr present.

June: Fritz put in swing. Became quiet in swing after several months. Firecrackers exploded near dog in camera in Nov. Again became restless, but ate food whenever offered. About 5000 repetitions of cs were given.

1934

Complete rest from experimentation in paddock.

PETER

1933

Nervous disturbance gradually incr
often could not be coaxed up on table
Apr.: Impossible differentiation introd
restlessness greatly increased with
barking, marked trembling, scratching
salivary disc, refusing to eat after first
Had to be taken by force into C. Would
food in antecamera. Ran in opposite
tion when told to jump on the stand.

May: Became quieter, would jump on
after much coaxing, looked at food but
quently refused to eat it. Ate in C
table or floor at end of experiment,
preferred to run out with food in his
Barked when he ate ovals from the table
antecamera ate normally. Often dropped
barking furiously. Ate new kind of
readily in C.

Small normal cr persisted to tones.

June: Became quieter, sleeping in inte
between crs.

Aug. to Oct.: Two months' rest.

Refused food in C; unimproved. Repe
tone 1024 continued till Nov. with
200 repetitions daily. Placed in swing
blank cartridges fired as with Fritz;
sulting antipathy to the C disappeared
one month's rest though he still refused
during the experiment.

1934

After two months' rest, quieter in C,
ate during experiment.

May: Experiments discontinued.

NICK

1933 (continued)

13 Oct.: Tactile csi introduced. Shows great restlessness—prancing, turning head away from food, whining when food dropped. Greedily eats food when released from table. Marked odor hydrogen sulphide emanated from him in C. Refuses to eat from hand H.S., though will eat from R.B.L. After month's rest to 29 Nov. no improvement.

First put in harness on table 30 Nov.; no aggravation of disturbance.

Dec.: Definite steps of putting dog in C seemed to have a summating inhibitory effect on acceptance of food. Definite pattern of hyperactivity when brought down from experimentation.

1933

26 Jan.: Heart rate in C 145; outside 120. Secretory crs have now all dropped to zero.

Drops food from mouth while outside C during activity of tone, but began eating about 15″ after tone.

Inhibitory behavior varies with distance from tone.

15 Mar.: Cinema made.

16 Mar.: Refuses meat in C even with coaxing though eats it when put into mouth. Negative toward food. Tones brought closer together.

10 Apr.: 1 tone used throughout with random reenforcement; routine experimentation continued till 5 July, then discontinued till 1934.

14 Apr.: Fumbles with food, dropping it from mouth.

July: Blank cartridges fired in C near dog. Eats all of food in paddock. Sometimes closes eyes in C but never sleeps. Marked trembling when blank cartridges were fired. Brings food from the C to the outside before eating.

1934

Jan.: Placed in hammock to increase nervous tension.

Jan.: Cortin given without improvement.

3 weeks' rest end Jan.; no improvement.

Routine experiments continued throughout Aug. Nick has been given 9335 repetitions of tones as csi.

August 1934 to July 1936: Rest in laboratory paddock for 2 years.

FRITZ

1935

Differentiation of tactile csi tried; ate food and gave positive secretory and positive motor crs.

1936

Rest in paddock.

1937

2 Apr.: Good retention of food crs. and differentiation. Defense reactions have disappeared; eats greedily from box.

1938

May, June and July used in study of alcohol on sexual reflexes. Quiet and cr activity in C normal. Died Nov. 1938, apparently from old age.

PETER

1935

18 months' rest till September. Pe
much improved; quiet in C, secre
retained; ate food readily even in
of old and difficult csi (Tone, etc.).
about 5000 repetitions of food csi.

1936

No return of nervous symptoms. Kille
ing in October.

NICK

1935

Rest in laboratory paddocks. Excellent physical condition. Does not eat in C though eats greedily in paddock; no improvement when brought down to C.

1936

crs measured in C; very small and irregular.

16 Oct.: Until 18 May 1937 Nick fed whole daily ration of meat in C to transform painful into pleasurable environment.

Only slight and brief improvement resulting from above procedure. Spread of disturbance to involve respiration, urinary and sexual systems. Stereotyped pathological pollakiuria noted from now on. Great hyperactivity in experimental environment. Special type of respiration resembling asthma. Shows definite differentiation in behavior toward usual experimenter and others. Grovelling and fawning. Agitation increased somewhat by presence of other dogs in C. Reactions to former position of tone in contradistinction to actual present position.

27 Nov.: Normal sexual activity and somewhat quieter in C.

16 Dec.: Reciprocal relationship noted between sexual excitation and defense reaction—former inhibiting the latter, with gradual return of usual defense reactivity. Excessive pollakiuria.

22 Dec.: Normal sexual relation with dog in estrus; less anxiety for several weeks.

1937

5 Jan.: Activity record shows dog more quiescent after sexual excitation.

13 Mar.: Pathological generalization noted; rejects food formerly used in experiment, as well as meat during action of tone, but eats it a few minutes after cessation tone; definite time relation between action of tone and eating.

20 May: Sexual erection to metronome. Neutral visual stimulation made pathological by association with tone. Sexual erection becomes stereotyped in C.

10 June: Reciprocal relations between sexual excitation and anxiety; long refractory period of sexual excitation.

June, July: Experiments demonstrating that anxiety produced in C inhibits normal sexual excitation.

1 Aug.-3 Oct.: Rest on farm in Va. Negativism toward laboratory associate while on farm, but friendly toward strangers. Defense reaction toward laboratory food given on farm. Increased restlessness and pollakiuria with erection after painful experiences on farm.

6 Oct.-11 Nov.: Test in laboratory showed dog much improved by rest on farm, but former symptoms (panting, sexual erection, hyperactivity, restlessness) gradually return.

1938

3 Jan.: Former natural conditioned food reflexes, as well as artificial conditioned food reflexes, but not unconditioned food reflexes inhibited by C.

12 Jan.: Human social factor dispells anxiety; but not presence of other dog, even female dog formerly in estrus.

NICK

1938 (Continued)

7 Apr.: Visual stimulus recently associated with pathological auditory stimulus contin[...] elicit anxiety.

From 17 May for about 1 year: Effect alcohol tried on sexual reflexes: large doses a[...] other dogs inhibits sexual reflexes, but contrary to normal, there is increased sexual excita[...] on intervening days.

1939

11 Jan.: Progressive increase of anxiety as dog approaches C from a distance. Defense re[...]tion noted toward members of families of those who worked with Nick in laboratory.

Heart rates accelerated in C.

Apr., May, June: Conditioned sexual reflexes very difficult to elaborate to artificial csi.

11 May: Nick gives pathological reaction to verbal associations. Sexual erection and pol[...]kiuria continue. No improvement, but stereotyped pathological reactions have become fixe[...]

25 Aug.: Nick taken to farm in Va. for 17 months' rest. Fall in heart rate from 200 i[...] laboratory to 110 on farm, few days after change. Heart rate markedly increased by m[...] approach on farm with appearance of other anxiety reactions. Nick's learning capacity st[...] acute.

12 Sept.: Aggressive bulldog threatening Nick as well as cat clawing him causes less acce[...]eration of heart than food or other associations of laboratory.

Oct.: Peculiar type of defecation, accompanied by erections.

Dec.: Urinates on food formerly used in laboratory.

1940

Feb. Mar. and May: Nick kept on leash on farm until summer. Friendly with farm atten[...]ant in contrast to attitude toward me. When I approach erection and ejaculation with po[...]lakiuria and increased heart rate. Also family association produces sexual erection, which [...] begins when person is 40 or 50 yards distant and increases as person approaches.

Allowed to run loose and accompany me during summer, Nick becomes more friendly, the[...] is less restlessness and decreased pollakiuria. Becomes very loyal towards me, following m[...] devotedly around on farm, running after automobile, etc. Simultaneously becomes quiet [...] house, does not urinate there as formerly, lies contentedly at my feet.

12 Oct.: Presence H.S. on farm evokes urination and slight anxiety reactions, but less cardi[...] acceleration than when he was in laboratory.

1941

14 Jan.: Returned to laboratory. Prefers strangers to laboratory collaborators (W.H.G. an[...] H.S.). 24 hour activity less than before sojourn on farm.

16 Jan.: Marked increase heart rate when H.S. passes in front of window momentari[...] even with Nick in next room. Sexual erection, pollakiuria, and anxiety reaction contin[...] toward personnel of laboratory, but less than before rest on farm.

Feb.: Erection when I reprimand him. Restlessness increased by bringing female in estr[...] through adjourning room.

NICK

25 Feb.: Normal sexual coitus, with inhibition food excitation by sexual excitation. Quieting influence of human companion in C noted.

27 Feb.: Inhibitory effect of C on both anxiety reaction and normal sexual reflexes is much less than before rest on farm, though they still demonstrate influence of laboratory environment. Slight erections continue to appear in laboratory environment. Nearly all of the stereotyped pathological defense reactions are present when dog is taken to old laboratory environment, but to a lesser degree than formerly. Normal and unusually active coitus with dog in estrus. Physical condition has remained good. C has less inhibitory effect on sexual reflexes than before rest on farm.

1942

Nick has been under observation 12 years, having had in this period over 10,000 repetitions of the csi. For the past 8 years these csi have elicited the defense and not the original food responses. He continues in good physical condition except for gastric hyperacidity.

Marked improvement by using former pathological csi as active csi for a shock on the leg; Nick forms these new crs fairly well. During this procedure there were no sexual erections—in contrast to their constant appearance in the old environment; also no pollakiuria. This procedure abolished anxiety reactions to the specific signals but not to the total environment nor to the people most closely associated with him in the experiments, to whom he remains negativistic.

1943

Nick's condition continues improved. Even when returned into the old environment of conflict he shows much less of the original anxiety-like disturbances. The former manic-like activity has diminished, spontaneous sexual erections have almost disappeared, though there is still pollakiuria and the peculiar type of breathing. Nick continues to differentiate and to give fairly good performance in the experiments using defense reflexes instead of the food reflexes. He shows a remarkable diminished sensitivity to the injection of adrenalin—even in doses large enough to be fatal to normal dogs.

2. Case Histories

A. FRITZ

A parotid fistula was made on 20 May, 1931. Fritz was accustomed to the experimental camera by feeding for a period of about four weeks before experimentation, the doors being left open. In the early part of June a tone of 1130 cycles (T1130) was introduced as a positive conditional stimulus. The secretory cr first appeared on the thirteenth repetition and was fairly constant by the ninth day after thirty repetitions. Tone 1130 was used by itself as a positive cs until 5 August, 1931. During this period there was no evidence of any disturbance of behavior, the animal standing quietly without ever barking or appearing restless except for slight panting.

On 5 August differentiation of another tone was introduced for several days without disturbance.

On 17 August a problem of irradiation of inhibition arising from tactile csi was carried out on this dog, without disturbance of behavior.

On 10 February, 1932, partial deafness was produced by destruction of the internal ear. (Operation by Dr. Walter Hughson.)

Daily experimentation with the tactile and the auditory (tone) csi was continued 14 March, 1932. At this time Tone 1130 had been applied 700 times, when it gave a 100 on the scale division for 10 seconds. On 14 March a differentiation of two pai tones, one in ascending and the other in descending order, was begun. The negative cs T530 given for 1 second followed by a T420 for 18 seconds; the positive cs was the Tones in reversed order, T420 given for 1 second and T530 given for 8½ seconds feeding, the two tones being separated by an interval of ½ second in each combination sample protocol follows.

TABLE 9

DOG: FRITZ APRIL

Conditional Stimulus					Conditional Reflex					
Order of stim.	Time	cs.	No. repeti-tions	Durat. of meas-ured cs.	L.P. secre-tory	L.P. motor	Size of secre-tion (cr)	Motor cr	Rein-forced (US)	S[illegible] UR se[illegible]
1	10:32	Tone 1[1]	732	10	2	6	130	+	+	[illegible]
2	10:35	Tone 2	57	20	10	—	125	—	—	—
3	10:38	Tone 2	58	20	—	4	0	+	—	—
4	10:41	Tone 3	52	10	20	14	10	+	+	[illegible]
5	10:44	Tone 2	59	20	5	18	57	+	—	—
6	10:47	Tone 2	60	20	—	4	0	+	—	—
7	10:50	Tone 3	53	10	4½	3	5	+	+	[illegible]
8	10:54	Tone 2	61	20	10½	5	45	+	—	—
9	10:58	Tone 3	54	10	4½	4	5	+	+	[illegible]
10	11:01	Tone 1	733	10	4?	5	15	+	+	[illegible]

[1] Tone 1=1130 cycles; Tone 2=530 cycles (1″) followed in ½″ by 420 cycles for 8½″ or 18½″; Tone 3= cycles (1″) followed in ½″ by 530 cycles for 8½″ or 18½″.

During this period an opportunity arose for observing the effect of severe fighting p the presence of a rutting female in the same paddock with Fritz, and to compare this with t effect of fighting on other labile and stable dogs; and also to see the difference in the behav of Fritz and Nick in the same paddock. On the 26 and 29 of March, 1932, the cr to T 11 was 195 and 150 respectively, and the UR 420 and 600. On 30 March it was seen th Fritz had been wounded in a severe fight, having gashes about his head and eyes with mu swelling. He was with difficulty coaxed to come out of the paddock, showing reluctance leave the female. On 1 April the cr to T1130 had dropped to 75, the UR remaining 14 The crs remained somewhat low for the next few days—130 on 2 April, 70 on the 4 and 90 on the 6th, the UR being 475 on the 2nd and 310 on the 6th. There is thus se to be not nearly so marked a disturbance in the cr activity in Fritz caused by the fight as th was in Kompa and Blue; Fritz and Billy were both stable dogs showing about the sam disturbance. The female in estrus also produced less of an effect upon Fritz than it did up other dogs, e.g., Bamech (q.v.).

The note on Fritz at that period stated: "8 March evidence of fighting over dog in estr Fritz had deep tooth gashes about his head. In order to bring him out of paddock he had t be forcefully pulled away from dog in estrus which he was attempting to mount. Nick h retreated to a corner by himself. 11 March, Fritz again very bloody and cut up; could n be coaxed out of his paddock. It was seen that Fritz would viciously attack any dog th came near the female in estrus. During same period, from 23 March to 9 April Nick's

to T1130 varied from 30 to 90, and the UR from 100 to 185. Nick did not enter into the fights nor was he seen to approach the dog in estrus, although the variation in his crs was as much as in Fritz."

Differentiation had become fairly well established by the end of June, after 600 repetitions of the negative chord and 300 of the positive:

On 21 July, 1932, a new differentiation between two other tones was started. Differentiation was complete by 26 August, 1932, the positive chord giving an average of 70 and the negative of 5, after the positive had been used 163 and the negative 327 times respectively.

On 6 October, 1932, after a rest of 2 months, another and closer combination of tones (represented in the protocols by T20-T21 positive and T21-T20 negative) was introduced. Slight differentiation was seen by 21 October after 65 and 140 trials of positive and negative respectively. Often there was non-reactivity on the cr (salivary) level (Table 10).

TABLE 10

DOG: FRITZ — NOVEMBER 23, 1932

Conditional Stimulus				Conditional Reflex						
Order of stim.	Time	cs.	No. repetitions	L.P. sec.	L.P. mot.	Size of secretion	Motor r	Reinforced US	Size UR 60 secs.
1	10:42	A[2]	237	1	6	35	+	+	570
2	10:44	B	450	—	—	0	—	—	
3	10:46	B	451	—	—	0	—	—	
4	10:48	B	452	—	—	0	—	—	
5	10:50	A	238	—	8	0	+	+	575
6	10:52	B	453	—	—	0	—	—	
7	10:54	B	454	—	—	0	—	—	
8	10:56	A	239	8	8	10	+	+	585
9	10:58	B	455	10	—	30	—	—	
10	11:00	A	240	9	8	10	+	+	600

[2] Tone A (T20–T21) is a combination of two tones close together in pitch, T20 given for 1½ second and T21 for 9½ seconds before feeding and 10 seconds after feeding.
Tone B (T21–T20) is the same stimulus as A except given in reverse order i.e., T21 for 1½ second followed by T20 for 19 seconds without feeding.

During December 1932 Fritz was occasionally very restless, but most of the time quiet. When the differentiation was good, instead of restlessness (panting and shifting weight from one foot to the other) there was drowsiness during the negative csi. Differentiation by 6 March, 1933, was manifested in both the motor and secretory latent period as well as in the salivary secretion (protocol 6 March).

As there was only slight disturbance to the above differentiation, two new tones of closer proximity were given. Although the animal was unable to differentiate, the behavior appeared undisturbed.

On 10 April, the two tones were replaced by tones of equal pitch, the first, 4th, 5th, 9th and 12th being reinforced, and the 2nd, 3rd, 6th, 7th, 8th, 10th, 11th unreinforced. To this practically impossible differentiation[3] Fritz became almost non-reactive during the arti-

[3] Differentiation by position is possible with simple alternation but very difficult with the above order. See Gantt, W. H.: Role of the Isolated Conditional Stimulus in the Integrated Response Pattern, and the Relation of Pattern Changes to Psychopathology, J. Gen. Psychol., vol. 123, pp. 3-16, 1940; also Chapter IV of this monograph.

ficial conditional stimulus (tone) though not to the stronger natural cs (sight of food); readily took the food as soon as it dropped.

The motor crs were absent but the secretory present.[4]

The typical behavior of the animal at this time was: with each conditional stimulus, whimpering, great restlessness, climbing on the food box, panting, barking, sometimes viol yelping, though he never refused the food in the camera. Occasionally he stood perfe motionless during the cs.

At this time he was in the same paddock with a female in estrus. There was no inhibiti of the secretory reflexes; immediately after the experiment he tugged to return to his paddo and there attempted to mount the female. The presence of the female apparently increa his restlessness in the experimental camera. After the female was removed Fritz, Peter a Nick were put together in the same paddock.

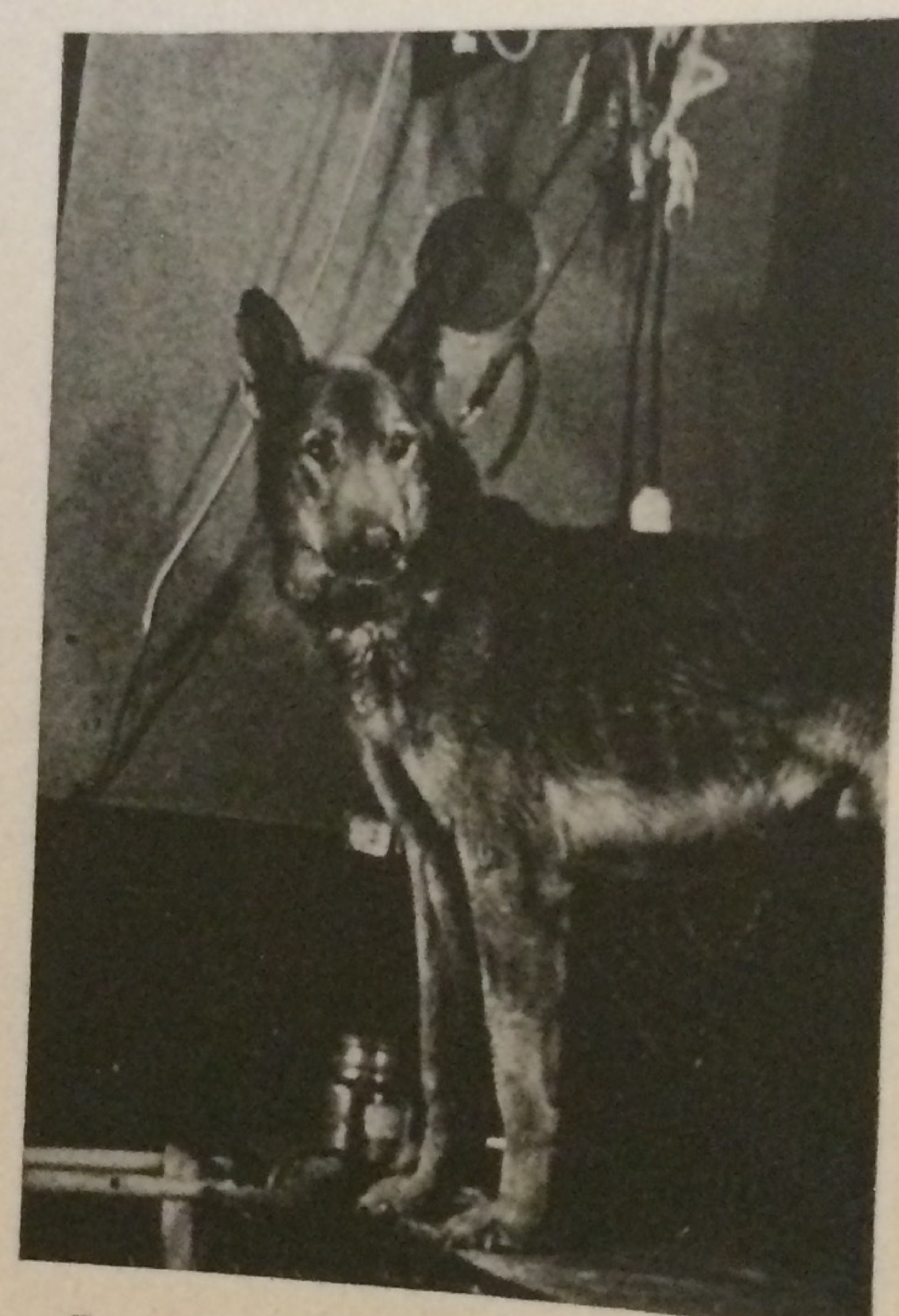


FIG. 8. Fritz in 1938 listening to same tone as Nick in frontispiece and fig. 39. Shows normal orienting reflex (attitude of interest) without trace of former conflict.

Fritz was put into a swing, as were th other two dogs, in June 1933 to increase th tension. His behavior became much quie after several months (in October 1933), fre quently resting his head on the stand as i going to sleep.

On 8 November, 1933, firecrackers we exploded in the camera with the dog. He agai became restless, panting, jumping about. Suga tolerance experiments (Diethelm) were char acteristic of anger. The next day he tore th disc from his face but continued to eat whe ever food was offered.

In September 1935, after a rest of about months, Fritz was brought down and put o a new routine, the differentiation of tacti stimuli. He continued to eat and give norma positive secretory and motor crs. He was teste in the camera again on 20 April, 1937, afte a rest of 18 months. As a result of this rest the nervous symptoms and the defense reactio had almost completely disappeared; and he had excellent retention of the food crs, with dif ferentiation of the positive cs (M20) from the negative tone. The only trace of the defens was slight agitation and panting to the negative tone. Throughout the experiment he sa

[4] This discrepancy regarding the durability of the crs belonging to different categories—moto secretory, respiratory, cardiac—has been observed in this laboratory on many occasions. E.g., a dog wh after a lapse of 18 months had completely forgotten with his muscular and secretory systems remembere perfectly with the cardiac crs, i.e., showed no loss of the cardiac component of the formerly establishe food crs (experiments with M. Tunick). The differences between different crs makes it unwise t generalize about human behavior on the basis of the study of only one kind of cr, e.g., food, or one type o measure, e.g., secretory.

or stood quietly. On 6 May, 1938, after 2 years' rest without intervening practice, he ran actively into the camera, gave a strong motor food cr toward the food box and ate greedily the food when it dropped into the box, showing spontaneous restoration of conditional reflexes without trace of conflict. During May, June and July, 1938, he was used in the camera for a comparative study with Nick of the sexual reflexes (see Ch. VI). His behavior was quiet and conditional reflex activity normal until his death in November 1938, probably from old age (12-15 years old).

Figs. 8, 21, 22, 39 illustrate the contrasting behavior of Fritz and Nick in the same environment.

B. PETER

Experimentation began in July, 1931 by feeding the dog in the camera. A cr was elaborated to a tone of 1130 cycles; it was formed on the first trial and continued thereafter with some irregularity. During the first month the animal was quiet with occasional barking toward the end of the month. There was no refusal to eat. A sample protocol is shown below (Table 11).

TABLE 11

DOG: PETER — AUGUST 8, 1931

Conditional Stimulus				Conditional Reflex					
Time	cs	No. repetitions	Durat. of meas. cs	L.P. secretory	L.P. motor	Size secretion	Motor	Reinforced US	Size UR 60 secs.
9:55	Tone 1130[5]	117	10/20	2+	1+?	59	+	food	225
10:03	Tone 1130	119	10/20	3	1+?	49	+	food	277
10:10	Tone 1130	120	11/21	1	1?	70	+	food	257
10:17	Tone 1130	121	29/39	2+	?	182[6]	+	food	—
10:25	Tone 1130	122	11/21	2	?	58	?	food	245

[5] Tone 1130 = 1130 cycles per min. given 10 seconds before food and 10 seconds after food is dropped (10/20).
[6] Reading for 29 seconds instead of usual 10 seconds.

On 13 August the dog was put in the harness for the first time. A tactile stimulus was alternated with the tone. After 1 to 4 repetitions of the tone a positive cr was formed to two tactile stimuli and later differentiation was made to two others.

In November the cr to the tone became irregular and dropped from its previous value of 40 to 10. With the increase in difficulty of differentiation the barking also became more pronounced, and some aversion to food appeared; in December the animal frequently turned away from the food before eating it.

A study of irradiation of inhibition was carried out without imposing a special burden on the animal.

In March 1932 a differentiation of the two pairs of tones in ascending and descending order respectively was begun. The positive cs was the tone of 420 cycles followed immediately or with a very short pause by a tone of 530 cycles and the negative cs was tone 530 followed by tone 420. Differentiation was established toward the end of March 1932 (Table 12).

A second differentiation where the tones were somewhat closer together was introduced; after several months, differentiation was readily established. Toward the end of the year,

TABLE 12

Dog: Peter — March 2[illegible]

Conditional Stimulus				Conditional Reflex					
Time	cs	No. repetitions	Durat. in sec. of meas. cs	L.P. secretory	L.P. motor	Size secretion	Motor reflex	Reinforced US	Size UR [illegible] sec.
10:13	Tone 1[7]	543	10	1	+1	216	+	food	[illegible]
10:17	Tone 2[8]	544	20	+1	1	322	+	—	—
10:22	Tone 3[9]	545	10	3	1	210	+	+	[illegible]
10:27	Tone 2	546	20	1½	3	564	+	—	—
10:32	Tone 3	546	10	2	2	560	+	+	[illegible]
10:37	Tone 2	547	20	1	1	402	+	—	—

[7] Tone 1=Tone 1130.
[8] Tone 2=Tone 530 for 1 sec. followed in ½ sec. by Tone 420 for 18½ sec.
[9] Tone 3=Tone 420 for 1 sec., and after an interval of ½ sec. Tone 530 for 8½ sec. before food and contin[illegible]
10 sec. after food (20 sec. altogether).

however, some disturbance of behavior was noted, such as barking when he was in the cam[illegible] alone and after eating as well as during the intervals—in spite of the good differentia[illegible] The animal now began to run away from the camera and would enter only with coaxing; he jumped off the table whenever he was not prevented. Barking and whining became m[illegible] frequent. A strong fecal odor was observed in the camera—also noted with Nick and othe[illegible] dogs but not with Fritz when subjected to a nervous stress. Sometimes Peter refused to e[illegible] jumping down and running away.

The differentiation of an excitatory tone and a descending pair of closely pitched inhi[illegible] tory tones was continued, the tones being brought somewhat nearer together. The anim[illegible] differentiated after repeating the positive pair 540 times and the negative pair 980 tim[illegible] However the nervous disturbance increased: the animal was more difficult to coax into th[illegible] camera, when the salivary disc was attached he howled and shook it off as soon as the d[illegible] was closed, struggled when it was replaced.

TABLE 13

Dog: Peter — October 22, [illegible]

Conditional Stimulus				Conditional Reflex				
Order of stim.	Time	cs	No. repetitions	L.P. (sec.) sec.	L.P. (sec.) mot.	Size secretion	Motor r	Reinforced US
1	11:18	A[10]	32	1	4	165	+	+
2	11:20	B[11]	67	—	—	0	—	—
3	11:22	B	68	—	?	0	+	—
4	11:24	B	69	—	6	0	+	—
5	11:26	A	33	—	6	0	+	+
6	11:32	A	34	1½	5	110	+	+
7	11:34	B	70	1	—	95	—	—
8	11:36	B	71	—	—		—	—
9	11:38	A	35	2½	3	165	+	+
10	11:40	B	72	—	—	0	—	—

[10] A=T20–T21, i.e., two tones close together in pitch (not calibrated accurately), T20 given for ½ second fol[illegible] lowed by T21 for 9½ seconds before feeding and continued for 10 seconds after feeding.
[11] B=T21–T20, i.e., the same two tones in reversed order, T21 for ½ second followed by T20 for 19 second[illegible] not accompanied by food.

A more difficult differentiation was next established, while maintaining those which had already been formed. The nervous disturbance gradually increased: there was whining, crying, great resistance to attachment of the disc, barking; restlessness and incessant wagging of the tail. Sometimes he could not even with coaxing be induced to jump on the table which he formerly did eagerly.

Table 14 for 4 April shows that the positive crs which were irregular but still positive on 22 October (Table 13) have now become uniformly inhibitory, so that the dog has neither positive secretory nor motor crs. In spite of the drop in the crs it is to be noted that the URs retain their former strength.

TABLE 14

Dog: Peter — April 4, 1933

Conditional Stimulus				Conditional Reflex					
Order of stim.	Time	cs	No. repetitions	L.P. (sec.) sec.	L.P. (sec.) mot.	Size secretion	Motor r	Reinforced US	Size UR 60 sec.
1	11:12	C[12]	30	9	—	10	—	+	445
2	11:16	D	60	?	—	?	—	—	
3	11:18	D	61	?	12	?	+	—	
4	11:20	D	62	?	—	?	—	—	
5	11:22	C	31	?	9	?	+	+	505
6	11:24	D	63	?	—	?	—	—	
7	11:26	D	64	?	—	?	—	—	
8	11:28	D	65	?	—	?	—	—	
9	11:30	C	32	?	—	?	—	+	565
10	11:32	D	66	?	—	?	—	—	

[12] C=T24–T25, i.e., two tones closer together in pitch than T20–T21 given in ascending order with feeding; D same two tones given in descending order without feeding.

On 10 April an impossible differentiation was introduced, i.e., giving the same tone (1024) twice in succession separated by a short pause and reenforced with food a certain number of times and failing to reenforce it at irregular times. Thereafter a great disturbance in the behavior resulted—terrific howling, barking, marked trembling; now the animal never could be coaxed up on the stand. Peter whined and howled when the disc was applied and almost immediately scratched it off. After the first stimulus each day he refused to eat. During the latter part of April he could not be coaxed beyond the door of the camera, and when he was put on the stand and the harness fastened he struggled violently, barked and whined. Later he would enter the camera after having been first fed some ovals outside, but when commanded to jump on the stand inside he would run in the opposite direction or crawl under the stand. Howling and barking increased, beginning even to the click of the switches for turning on the apparatus, an act which had been noted for several weeks. Panting, barking and whining would alternate with some quiet periods.

In May 1933 he became more quiet, and after about 10 minutes of coaxing would jump up on the stand; but he barked furiously when the collar was attached, later becoming very quiet once the conditional stimuli were given. Frequently he looked at the food but would not eat it.

After the experiment Peter ate more readily, either from the hand or floor or table in the camera, though he often would take no more than 2 ovals and preferred to run out of the

camera to eat these. When coaxed to take the ovals from the table he would look at them and turn away barking. Outside the camera he would eat avidly. The behavior was the same in the camera even after the restraining harness and salivary disc were removed.

Toward the end of May it was seen that the animal did eat from the hand after he had been put on leash, though he would often mouth the biscuits, drop them without chewing (as Nick did) and bark furiously.

On 25 May even outside the camera Peter took the ovals in his mouth, dropped them and barked loudly, or would bark violently when he was only offered the food or it was brought near his mouth. Inside the camera he would look at the oval as it fell then turn away. When offered a different form of food outside the camera (purina checkers instead of Spratts ovals) he ate them readily. This reaction toward the two types of food was evidently due to the association of the food with the experiment, rather than to the nature of the food, as the dogs had no aversion to this food before it was used in this experiment.

During this period there was still a small cr to both the reenforced and unreenforced tones.

In June the animal gradually became more quiet and sometimes ate from the food box though not during the experiment. On 23 June, he slept in the interval between the cs's, kept his head on the food box with eyes half closed. On 28 June, he was agitated and quivering, romped about the room, rapidly gulping several ovals. Refused to enter C. Strong odor from flatus soon after entering C.

In order to investigate the changes in sugar tolerance it was attempted to intensify the emotional upset by putting the animal in a swing on the table and firing blank cartridges in the camera. Peter trembled but there was apparently no effect on his usual reactions.

The dog was given two months' rest from August to October 1933. When returned to the camera afterwards his behavior was about the same or worse; he refused food in the camera although offered by hand, whining loudly when coaxed to eat or bursting into yelps and barks. On the floor of the camera he ate readily. Sometimes Peter could be persuaded to eat by forcibly pushing food into his mouth.

Occasionally the sight of the ovals placed before him would elicit furious barking. During October the same marked fecal odor was noticed as previously when the dog went into the camera. Peter ate voraciously in the room outside the camera.

The repetition of T1024 was continued until 7 November, 1933, for over 3000 trials.

In an attempt to create as serious a condition in Peter as in Nick, during 1933 he was given many more daily repetitions than usual—routinely 60 and sometimes 200—at minute intervals. Blank cartridges were fired near him in the closed camera, and at other times loud fire-crackers were exploded. Although this procedure and the difficult differentiation produced marked behavior disturbances while the dog was in the camera, a short rest restored him to near normal. Thus when tested on 6 December, 1933, after a month's rest he ran promptly into the camera, jumping without hesitation on the table and eagerly ate the food at first; during the experiment he refused food, but ate out of the food box without coaxing when the door of the camera was open and someone was with him. After another rest of two months—until 17 February, 1934—he was quieter and ate all the food in the camera even after Tone 1024.

This dog was next given a rest of 19 months—until 13 September, 1935. On that day

and at intervals throughout the year his behavior was fairly quiet, there was little or no barking, no restlessness, he gave positive secretory food crs to the former csi, and usually promptly ate the food. Prolonged rest in this animal was evidently sufficient therapy to restore him to normal, in marked contrast to Nick. Peter was killed while fighting on 25 October, 1936, without showing in this interval a return of the nervous symptom.

C. NICK

1932

Experimentation was begun on 5 February, 1932. The animal was accustomed to the camera by the usual procedure—food every 1 to 5 minutes for several weeks before giving any csi. Although no abnormal behavior had been noted in him previous to his being brought into the camera, during the first month of experimentation he appeared somewhat restless—climbing on the food box, and shifting about on the table.

Some clue to Nick's susceptibility to the experimenter was seen on 5 February, 1932, the second day after he had been brought into the camera and the salivary disc applied to measure the crs. On 4 February Nick was severely punished by a collaborator for scratching off the salivary disc from his face. On the 5 February he would accept only 4 feedings, although he had been eating readily up to this time. A note was then made as follows: "would not eat—probably afraid of experimenter for being so severely punished yesterday. Did eat biscuit outside camera."[13]

After this there was no disturbance in behavior nor refusal of food until 15 February when an artificial cs (T1130) was given for 10″ preceding each feeding. He would not eat until the camera was entered and he was fed by hand. On 16 February the following note was made (R.B.L.):

> Terribly excited by stimulus, turned to food but did not eat until entered and fed. Frantic twisting of head and neck. Whining sharply. Ate only 2 or 3 minutes after food dropped. Got so excited almost pulled collar off head. Squeals each time tone begins. Quiet in interval.

The cr first appeared on the 34th to 39th repetitions.

It is important to note that this animal became extremely restless at the first elaboration of the cs, and not only, as with Peter and Fritz, when there was a difficult differentiation.

Throughout February he was restless in the camera. Usually he would not eat during the cs—but about 40 seconds later. As soon as the cs started Nick whined and became restless, although he had been quiet in the intervals. Occasionally he whined also after the stimulus. When the laboratory assistant (H.S.) stood in the door, his presence started the dog eating immediately.

During March the positive cs was continued; sometimes the animal would jerk his head and bark. On 15 March he jerked up his head to the stimulus as if he were avoiding a blow. In the intervals between csi he was much quieter.

On 7 April, 1932, in addition to the positive cs (T1130) a pair of ascending tones (A=T420-T530) was made a positive cs and the same pair in descending sequence (B=T530-T420) was made inhibitory by nonreinforcement (Table 15).

[13] As a rule in this laboratory as well as in Pavlov's, dogs are never subjected to any physical punishment.

TABLE 15

Dog: Nick — April 7, 19[illegible]

Conditional Stimulus				Conditional Reflex						
Order of stim.	Time	cs	No. repetitions	L.P. sec.	L.P. (sec.) sec.	L.P. (sec.) mot.	Size secretion	Motor cr	Reinforced US	Size UR [illegible] sec.
1	11:21	T1130	174	+1	$4\frac{1}{2}$	1?	30	+	+	545
2	11:24	A[14]	1	+2	$4\frac{1}{2}$	—	84	—?	—	
3	11:27	A	2	+1	$9\frac{1}{2}$	—	47		—	
4	11:30	B[15]	1	+1	—	—	0	—	+	500
5	11:33	A	3	+1	$3\frac{1}{4}$	—	66	—	—	
6	11:36	A	4	+1	$7\frac{1}{2}$	—		—	—	
7	11:39	B	2	+1	—	2	5	+	+	660
8	11:42	A	5	+1	$9\frac{1}{2}$	—	1	—	—	

[14] A=Tone 420 for 1 second followed by Tone 530 without food.
[15] B=Tone 530 for 1 second followed by Tone 420 with food.

From this protocol it is seen that Nick gave a weak cr to the T1130 and that he ate the food. Later, as will be seen, the secretory component of the food cr disappeared entirely.

In the first part of April, Fritz and Nick were together in a paddock with a dog in estrus. A note on the behavior at that time showed that Fritz was very aggressive in attempting to mount the dog and in sexual overtures towards her, very reluctant to leave the paddock to go to the camera, rushing back out of the camera to the paddock. When Fritz was under observation in the paddock at times he did not show any tendency to fight, at other times he made a vicious attack on dogs who approached the female in estrus, becoming badly wounded. Opposed to the behavior of Fritz in this situation was that of Nick; he sat in a corner by himself, exhibiting no sexual activity while under observation. This was not however a permanent characteristic of Nick; other times in his life he was seen to copulate actively and effectively. However he exhibited throughout his life alternating episodes of aggression and shyness.

On 13 April Nick was seen to turn (at the end of the negative csi) toward the door which was in an opposite part of the room from the food box. In retrospect this act appeared as one of the early elements of the conversion of the food reflex into the defense symptoms.

After about 140 trials, differentiation between the positive and negative combinations of tones was fairly good, and on 21 June after 300 repetitions of the positive and 655 of the negative csi, both the secretory and motor differentiation was established.

Thus on 21 June T(+) gave a secretion of 90, 65, 65, 35, 35, 35, 35, 35, 25 for the successive readings, while T(—) gave zero secretion throughout. The dog ate all the food offered. The corresponding URs were 230, 200, 160, 175, 180, 215, 205, 220, 145.

On 15 July a new combination of ascending and descending tones was introduced in which there was less difference in pitch between the two tones—therefore more difficult to differentiate.

On the next day he jumped from the stand without eating; when put on the leash he turned to the food but refused to eat until someone entered and coaxed him after which he would eat immediately. When the food shelf dropped, making a slight click, he would jerk his head away as if frightened. This action was the more remarkable as he had been starved for 48 hours. It was similar to that of Peter during the difficult differentiation.

Such behavior is evidence of the spread of the defense from its original focus about the negative conditional stimuli to include the positive as well. In keeping with the change of behavior—from the characteristic food reflexes to the avoiding, defense reactions—the crs even to the positive stimuli dropped to zero.

During this time he showed a gradual development of the defense reactions toward the negative stimuli: he turned away from the origin of the stimulus, looked toward the door, sometimes shook his head from side to side, sometimes restlessly looked all about the room, and often assumed a motionless position until the latter part of the stimulus, suggesting the *status marmoratus*. Sometimes he tore the salivary disc from his face. Besides the avoiding reactions toward the negative stimulus, in August his ears were seen to tremble, he shifted his feet, trembled all over and "frowned." On 24 August he refused to eat to the positive csi when the food dropped in the box, although at the beginning and at the end of the experiment he ate greedily.

From 27 August until 10 October, 1932, Nick was given a rest with the result that after this 6 weeks' interval he readily ate all the food offered him as seen by the protocol for this date.

On 10 October a yet more difficult differentiation of two tones very close together in ascending (positive) and descending (negative) order was introduced. On the first day Nick ate the food given with the positive pair of tones, but on the next day he refused it and thereafter *for the next 9 years throughout practically his whole laboratory life he accepted no food in the experimental camera either with the positive or the negative conditional stimuli.* Up until this time while in the laboratory the dog had never been mistreated or subject to any activity except for the punishment referred to in February. Although other elements of the situation before this and subsequently may have contributed to the substitution of defense for food reflexes, there is strong evidence in Nick as in Fritz and Peter that the laboratory environment and the difficult differentiation was chiefly responsible for the breakdown.

On 10 October, 1932, the secretory cr to T20-T21 (+) was zero throughout, and also zero to T21-T20 (—). Compare this with the good differentiation on 21 June. The URs on this day showed an average of 240, i.e., about the same as previously, illustrating the fact that there was no reduction in the physiological secretion of saliva.

The history from now on shows the comparison of the three dogs, and the persistence, development, and gradual involvement of many physiological systems as well as the stereotyped appearance of a train of symptoms in Nick.

In an attempt to increase the tension in the food center, and consequently the food reflexes, his daily ration outside the camera was halved, so that he received only 200 gms. of meat and 100 gms. of bread for several weeks. His reactions now, on the contrary (12 October), began to be continuously aggravated; he ate only from the hand and only after much coaxing; to the csi he backed away, shifted his weight from one foot to the other and on cessation of the tone he moved forward again, looking "anxiously" toward the door. A remnant of the food cr remained in the form of looking at the food box when he heard the food dropping, and licking his chops. There was also loud whimpering.

On 13 October two extraneous stimuli were introduced, a tactile stimulus on the skin, and the sound of a door bell. His defense reactions were now *generalized* not only to the

auditory stimuli but also to the tactile: during both of these he gave the same defense reactions as he had to the tones used previously for differentiation—prancing, turning of the head from the food box; when the cs stopped he whined slightly but sat on his haunches and ceased his restless movements. He refused food even from the hand. When the old difficult differentiation of the two tones was given without applying the salivary disc, the dog's behavior was as much disturbed on this day as it was when the disc was on. That he was hungry was shown by his eager hunt for food when he was released from the table. Having started to eat in this way, he seemed to be dominated for a while by the food excitation; for he jumped on the stand and while on the table on the leash continued to eat 250 grams of dry dog biscuit.

His nervous behavior was so marked at this time that he was demonstrated to the clinic. His behavior remained about the same—eating outside the camera, but refusal of food during some part of the procedure of hooking him up for the experiment, such as putting on the salivary disc or his collar. Often a marked odor of hydrogen sulfide emanated from him when in the camera. We have observed this in other dogs under conditions of strain. On 20 October there was evidence of a spread of the defense reflexes not only to all csi and attaching of the apparatus but even to being within the camera: he would not eat when entirely free in the camera though he would look at the food box. Even when the doors were opened and H.S. entered he would not eat, whining more vehemently as the food dropped from H.S.' hand into the box than he did in the intervals. On this day he could not be coaxed to eat on the stand, although when a biscuit dropped on the floor, he quickly jumped down and gulped it. On other days, e.g., 29 November, 1932, he would eat when R.B.L. entered the camera.

He was given a month's *rest*, but with resumption of the experiment on 29 November there was no improvement.

On 30 November his hind legs were put in a harness for the first time without appreciable change in his behavior, i.e., this added restraint did not aggravate the disturbance.

Frequently he would run to the camera without coaxing, jump up on the table and wag his tail.

At times (1, 3 December, 1932, et seq.) various steps in the preparation for the experiment seemed to have a summating influence in bringing out the defense reaction. On 1 December before the experiment he ate readily outside the camera, then ate 6 biscuits inside, and even 1 biscuit after the collar was attached to the leash, another biscuit hesitatingly after the salivary disc was applied and even a few biscuits afterwards until the csi were given, after which he started whimpering and refusing food. Conversely, on removing the attachments, at a certain stage he began to eat, but this seemed to be a continuation (irradiation?) of the defense reactions, just as there had been before the experiments of the food excitation, resulting in a changed threshold for some minutes after each excitation. Thus on 3 December, after the experiment he would not eat after the salivary disc was removed, nor when the straps were removed nor when the pneumograph was taken off, but only after the collar was released; then he jumped on the floor and quickly ate 700 grams of dry dog biscuit.

Some years later a similar persistence of a state of excitation was seen in the reciprocal relations between sexual excitation and defense symptoms, described below as refractory period.

1933

The alternation of the positive and negative tone combinations was continued until 6 April, 1933, accompanied by the same behavior as seen previously. During this time the secretory cr remained at zero and the dog never accepted food during the cs.

In this dog as in some of Pavlov's animals, a slight additional stimulus would often dissipate the defense reflex and elicit the food reflexes. For example on 9 January, 1933, when Nick was placed on the stand as usual in the camera, he refused to eat, but readily took food in the same situation when the food was placed in an aluminum pan in the food box. He had been customarily fed from this same aluminum pan in the antecamera. On this day when the pan was removed, the negativistic behavior immediately supervened; the dog rejected food by pushing it out with his tongue. After the eating initiated by the pan had been transferred to feeding by hand or from the box, Nick refused to eat even out of the pan.

On the next day Nick would not eat out of the pan, but on other days the pan had the same effect as on 9 January. Pavlov reports in some of his neurotic dogs a removal of the paralysis seen in the so-called hypnotic states by some such simple procedure as we have seen here by using the aluminum pan.[16] Sometimes a slight change in presenting the food as breaking the biscuit up would initiate eating: this was similar to the removal of the hypnotic state by Pavlov's variation in feeding by heaping the food in little mounds.

The motor phenomena, however, in Nick were almost never of the hypoactive, paralytic type but consisted in marked hyperactivity.

On 13 January, 1933, Nick exhibited a type of restless behavior which was repeatedly seen thereafter when he was released from the apparatus; he jumped off the table, gobbled up the biscuit which he had dropped from his mouth on the floor, dashed in and out of the camera, sniffing under the table, jumping on the table a number of times, barking at the biscuit on the table without eating it. Though he looked into the food box, he turned sharply away refusing the food he saw there. Previously he would dash in and out of the camera, but on this day there appeared in addition for the first time the pattern of defense which recurred regularly thereafter for nine years as described later. On the table he shook himself violently, as he had often previously done when in harness to rid himself of the salivary disc, for which action he had been rebuked or punished by a slap because it dislocated the recording system. Loucks described this as a "chain pattern leading up to the release of the inhibition to a state where he eats."

The secretory cr was now always zero.

Blood was removed from Nick during this year for blood sugar determinations, with occasional injections of adrenalin, the results of which will be discussed in Chapter VI, section 1.

During this period pulse rates were taken (by palpation) in the paddock in the antecamera and in the camera by both H.S. and R.B.L. Generally even at this early period the pulse was *more rapid when taken by H.S.* The measure of cardiac rates by palpation during this period was therefore not as accurate as later when electrical records were taken. The results are tabulated in Chapter VI, section 4.

On 15 February, 1933, the *pulse* rate in antecamera, dog on floor, was before experiment

[16] See Pavlov (*89*) [under "hypnotism"].

87, 85 (R.B.L.); 87 (H.S.); near end of experiment dog in camera 90, 110 (R.B.L.
On the 15 February Nick ate from the food box still standing on the table as soon as the
leash was taken off.

During February Nick frequently ejected food placed in his mouth. The strong sulfide od
was frequently noted in the camera. A sample protocol on 1 March, 1933, shows that the
was still zero, that he did not eat, and that his behavior was unchanged (whimpering, look
at floor, picking up crackers and dropping them, eating only at the end of the tone. Outside
the camera he would begin eating only about 15 seconds after the tone).

TABLE 16

Dog: Nick — 1 March, 19

Order	Time	CS	CR: No. repetitions	CR: Secretory	CR: Motor	Food	Behavior
1	11:17	Tone A-B[17]	574	0	0	+	yelps and backs away
2	11:19	Tone B-A	673	0	0	—	cries, backs away
3	11:21	Tone B-A	674	0	0	—	cries, backs away
4	11:23	Tone A-B	575	0	0	+	cries, backs away
							refuses food throughout

[17] Tone A and B were very close together and could hardly be distinguished by the human ear. In the stimulus *Tone A-B* tone A was given for ½ second, Tone B for 9½ seconds (at which time the food was dropped) and continued for 19½ seconds. In the combination *Tone B-A* tone B was given for ½ second and tone A for seconds without food. The above procedure was repeated for 20 times daily and later on for as many times as 160 times daily.

The above stimuli were repeated in such order until 20 had been given. On this date after the experiment when the dog was free on the floor of the camera eating biscuit, as soon as the tone was given he immediately dropped the food from his mouth, stood listening, and would not eat until the tone stopped. Also when taken outside the camera, a little farther from the tone, he dropped the food from his mouth as soon as the tone started, but picked it up and dropped it again. He resumed eating about 15 seconds after cessation of the tone. This type of behavior (*stereotyped pattern*) could be demonstrated at will during the next 6 years. Any auditory stimulus used in the camera would precipitate it. The inhibitory effect of the tone upon the act of eating and upon the food crs varied in intensity with the distance of the dog from the tone, a fact that could be demonstrated repeatedly.

During cinematographic recording of Nick on the 15 March, 1933, he showed no particular reactions to the lights and the noise of the photographic apparatus, evidence that his abnormal behavior is specifically related to those stimuli previously used in the camera rather than to *any* noise. Subsequently, the elaboration of a neutral stimulus (Light) into a pathologic one by association with the pathologic tone, is further proof of the specificity of the defense reactions in Nick, in spite of the spread to include closely related physical stimuli.

On 16 March, 1933, after the experiment, there was an attempt to coax the dog to take meat out of the food box in the camera, but he turned definitely away. When the meat was put into his mouth he swallowed it and would eat a little from the hand but not from the food box. Further coaxing produced a negative reaction—the dog refused to take food from the hand. Eating could be initiated again by holding his head in the food box close to the meat, when he would gobble it down rapidly, but he would not voluntarily continue eating

unless his head were held close to the meat in the box. He would not take the usual biscuit either by hand or from the box until after he was released from the stand, when he jumped up again and took a few biscuits with some hesitation and a suggestion of "ambivalence." *It is noteworthy that the effect of the meat, as well as that of the tone (noted previously), bears a definite relation to its distance from the dog.*[18]

After giving these two food tones—1003 repetitions for the negative and 765 for the positive—the pitches were approximated still closer so that it was impossible for the human ear to distinguish between the two. On 10 April, 1933, instead of using two tones of slightly varying pitch, a pair of tones of 1024 cycles each was introduced and repeated at 1 minute intervals 20 to 60 times daily, reinforced by dropping food irregularly to some of the tones. This was of course an impossible differentiation, but as the dog refused food consistently, probably all of the tones acted similarly to produce the definite reactions. These tones were repeated 9335 times until 5 July, 1934, when the routine experiments on Nick were discontinued.

On 10 April it was noted that the dog was much worse when in the camera alone with the door shut, and that he became more quiet if one of the experimenters was in the room with him or the door was open. Whining began as soon as the door separating the dog from the experimenter was closed and it continued with intermittent howling, barking; it was exacerbated by any one of the csi, during which he would suddenly back away from the source of the sound. When Nick was scolded in the antecamera, he would retreat into the camera and jump on the stand.

On 14 April, 1933, Nick began to pick up the biscuits and drop them from his mouth several times, running around frantically with them—described by R.B.L. as "fumbling." This became stereotyped and continued for many years whenever the dog was given ovals in the antecamera or in the camera.

On reducing the interval between csi from 2 minutes to 1 minute (24 April to the end of 1934), the above behavior was not aggravated.

In an attempt to study the blood sugar tolerance and to make the tension in this dog as great as possible, he was placed in a hammock (in the camera) which swung freely on the table next to the food box beginning 13 January, 1933, and continued daily for over a year to August, 1934.

On 15 June it was noted that Nick ate his meat in the paddock after he had returned from the experimental room as if his mouth were sore, i.e., he picked up the food, dropped it many times, similar to the fumbling with the biscuits seen in the antecamera.

On 19 June he refused to enter the camera, running away, and only after numerous commands was he induced to enter. During this month he also refused the oval biscuits in the antecamera, though he would eat other food, such as purina checkers or meat. This specific refusal of the food used in the camera is important because of the peculiar sexual reactions which this food elicited 6 and 7 years later in 1939 and 1940.

On 30 June in the camera his eyes were seen to be partly closed, although he was very alert. This was the nearest that he ever came to sleeping in the camera.

[18] Here and later with sexual reflexes it was repeatedly shown that there is an effect of distance suggesting the precision of what one usually sees in mechanics.

On 17 July and for some time afterwards, he would race madly about the room to the ovals around in his mouth, pawing them, but sometimes eating them in the antecam

On 13 July, 1933, blank cartridges were fired in the camera near the dog begin 13 July, 1933. On 20 July Nick jumped down from the swing, howling loudly as H.S. the first of four shots; and Nick repeated jumping down though he was replaced three ti This procedure seemed to increase his hyperactivity for the next few months but did change the pattern of his reactions. Further abnormalities will be described below as t occur.

He was given a rest from 8 September to 6 October, 1933, without any improvemen his condition. He still rushed madly about the room when the food was tossed to him, a outside the camera with much fumbling; in the camera he whimpered and whined as t food shelf was dropped. After the experiment he ate the ovals as usual but tossed them. W given purina checkers (a new food) he ate them without tossing or fumbling, though refused them inside the camera. Marked trembling of the body was noted. When the bla were fired there was terrific howling. When given checkers to eat inside the camera he wo bring them outside before eating them. On 28 October after being fed checkers several ti in the antecamera he also began to refuse these though not as consistently as he had the ova He was given a rest from 2 November until 6 December; after this he showed the sa excited behavior, fumbling of food, dashing in and out of the camera as he had done p viously. On 26 January, 1934, he took one oval, but refused all ovals after the salivary had been attached.

1934

After favorable reports on the use of cortin in diminishing anxiety-like overactivity, Thorn (*54*) in patients and Liddell (*71*) in sheep, we tried its effect on Nick.

On 25 January, 1934, 2 cc. cortin (Grollman's)[19] was given intraperitoneally, and the 26th 1 cc. was given at 8:00 at 16:00 and at 1:00 (night). When brought into th camera after this he appeared unchanged, refusing food, howling, whining at the slightes sound, lying down on the floor and refusing to eat even when coaxed, though he would the ovals and drop them. He appeared more fearful than ever.

On 17 January 1 cc. cortin was given every 8 hours as on the 26th. The dog appea definitely worse, retreating in the corner to the slightest sound, trembling and howling. Wh released from the swing he kept crouching beneath the apron of the experimenter. He wa not as hyperactive as usual but was more easily frightened. There was reluctance to lea the camera before the experimenter—an unusual act for Nick.

When taken outside the experimental room, Nick ate the ovals readily and upstairs ne his paddock he ate a half pan of ovals without any fumbling, continuing when even th hissing sound of compressed air was made similar to the one in the experimental room fr which he retreated. This as well as other experiments to come later definitely showed th effect of the total environment on the animal.

[19] The amount was calculated by Dr. Grollman to be the equivalent of the cortin that a normal do of Nick's size would produce in a day. Each cc. represented 50 units of cortin corresponding to dog units per cc. of the available commercial preparations.

On 28 January 1 cc. cortin was repeated at 8 hour intervals. Again he ate the ovals near his paddock and while coming down on the elevator, but in the experimental room he slunk around stopping to listen every few moments and only after great delay ate one or two ovals. He tossed his head wildly, whimpering and howling. After the experiment he again refused to leave the camera until the experimenter did. He ate a few ovals then with great fumbling and running around before eating each oval. When carried back to his paddock he ate readily in the elevator and near his paddock, ceasing momentarily when the hissing sound was made. Activity and other behavior in the paddock seemed to be normal.

At the end of January he was given a rest for three weeks without change in his subsequent behavior. 20 February he whimpered and cried while the food box in the camera was being filled. For the next few days he did eat some ovals inside the camera and while in the hammock without much coaxing. Again on 13 March he ate both in and outside the camera but he refused to take the biscuit from the food box. On 3 April he jumped twice out of the hammock and had to be strapped in. On 6 April he ate an oval even during the tone.

1936

Nick was given a two year rest, from 5 July, 1934, until 31 July, 1936. During this time he was kept continuously in his paddock on the 6th floor with the other dogs, sometimes in a paddock to himself. He had no special contact with the experimenter except when the latter would go up to get the other dogs.

On 31 July, 1936, he ate the ovals readily in his paddock, sat quietly in the elevator when brought down, in contrast to his usual frantic movements, and even ate readily in the antecamera. When ordered into the camera he dashed excitedly about, finally bolted in and jumped on the table. He refused to eat, turning his head away when offered the ovals, but salivating copiously. This negativism is comparable to that seen in Pavlov's cataleptic dogs who gave a marked salivary cr, even drooling at the mouth, but became "as rigid as marble" and were unable to move the front part of the body nor to take the food at which they remained staring fixedly.

When Nick was taken out of the camera he ate ovals again eagerly in the experimental room, with however some fumbling. He became excited when ordered back into the camera. There he ate the ovals at first, but later refused them.

Nick was in excellent physical condition during all this time.

When brought down on the next day he fumbled with the ovals and became excited on the elevator and refused all ovals in the camera.

It is thus apparent that the two year rest in the laboratory caused only a slight temporary improvement when he was returned to the same experimental environment.

It was later shown, in 1942, that the Tone could be transformed also into a specific motor defense cr to a faradic shock.

After the long rest there was a transient return of the salivary cr to the Tone. Thus on 27 June, 1934, there was an average secretion of about 7 mm. during 10 seconds action of T1024, but on 31 July, 1936, after two years' absence from the laboratory the cr to the Tone was on the first 10 trials as follows: 33, 108, 54, 25, 1, 4, 2, 13, 0, 0. The food was refused and there was no motor cr on either day. This indicates that the cr showed some

spontaneous restoration after the rest but was quickly inhibited after several repetitio[illegible] the dog was returned to the same environment.

In order to see if the same Tone could be transformed into a cs for the secretion [illegible] based upon defense instead of food (injection of acid into the mouth) beginning on [illegible] T1024 was given for 10 seconds and followed by 5 cc. of .05 percent HCl (squirt[illegible] the mouth through a mechanical apparatus with the dog in the usual camera). A [illegible] secretory cr appeared on 4 August, after 34 repetitions of the Tone followed by acid.

TABLE 17

Date	Time	CR				UR	
		Tone	No. repetitions	Secretory	Motor	US	[illegible]
5 Aug. '36	8:15	T1024	42	130	−	5 cc.	[illegible]
	8:19	T1024	43	150	+	5 cc.	[illegible]
	8:23	T1024	44	230	−	5 cc.	[illegible]
	8:28	T1024	45	145	+	5 cc.	[illegible]

Routine experiments using the csi for acid were discontinued after August 1936. F[illegible] next two years he was used in the same experimental environment for the study [illegible] development of the neurosis in the various physiological systems and therapeutic applic[illegible] as described below.

As possible factors to be considered in this extension of the nervous condition we[illegible] following: one of the experimenters most intimately associated with Nick (R.B.L.) and [illegible] whom Nick was perhaps more friendly than with the other two (H.S., W.H.G.), left Ba[illegible] more in August 1936; furthermore, H.S. who remained had fired the blank cartridges [illegible] Nick. Another factor to be mentioned was the bringing of a dog in estrus into the cam[illegible] with Nick in 1936—about the time that the pollakiuria became prominent. However, as [illegible] be pointed out subsequently, the dog in estrus seemed to have more of a quieting influ[illegible] than the reverse. Though there is no substantial evidence that the above factors were res[illegible] sible for the subsequent development of various symptom complexes, they should not [illegible] unnoticed.

From 16 October, 1936, until 18 May, 1937, Nick was given nearly every day his [illegible] ration of meat in the experimental camera instead of in the paddock as previously, and a[illegible] rule no tones or any artificial signals or stimuli were given in the camera. The purpose of [illegible] feeding was to produce associations in the experimental environment connected with a s[illegible] pleasurable excitation of an opposite nature to the conflict—eating food which he liked wh[illegible] he was in a state of hunger. The results of this type of therapy were disappointing. Ins[illegible] of showing marked improvement, Nick developed in the succeeding months new patholog[illegible] abnormalities of behavior, with evidence of the spread of the disturbance to involve s[illegible] physiological systems as respiratory, urinary and sexual neuroses, years after the original co[illegible] flict had been removed.

When brought down on 15 October, 1936, after a ten weeks' interval since the last [illegible] perimentation, Nick seemed more excited than usual. The agitation began as he approach[illegible] the room, coming down on the elevator. Inside the antecamera, though still outside [illegible]

camera, he dashed madly around, ignored three biscuits on the floor. He went into the camera after coaxing but ran out immediately. Food was refused until he got a certain distance away from the experimental room: he would not eat in the corridor nor on the elevator nor until he was returned to his paddock on the 6th floor where he ate meat and salmon readily but refused the Spratts ovals (experimental food).

At this time there was noted a peculiar type of respiration, which apparently developed during the rest period and was elicited by bringing him into the experimental environment again. This consisted of a loud, raucous breathing with quick inspiration and labored expiration. It was somewhat similar to that seen in the camera during the tone (see graphs Ch. VI) except that it was accompanied by a loud wheezing as if the animal were hoarse. It persisted from this time until the present (1942) whenever the dog was excited and particularly as he approached the experimental camera or anyone who had been associated with the experiments. When brought down from the paddock this loud, forced breathing would usually begin on the elevator and increase as the experimental room was approached, disappearing in reverse order. Although suggesting asthma, examination of the dog by an internist (Dr. Murray Fisher) showed that there was no true bronchial constriction except in the large bronchii, no typical rales, but an increased rate of breathing equivalent to a respiratory "neurosis."

Nick usually ate the pan of meat in the camera, though he often had to be coaxed. Frequently he would dash in and out very excitedly, panting, jumping up and down upon the table before he would finally begin eating. Simply attaching the leash to him, although it in no way interfered with his eating, frequently caused him to stop eating as if mechanically; but he would resume when the leash was unhooked.

Although the Spratts ovals were routinely refused inside the camera, Nick took them when they were cracked up and mixed with the meat. On those days when he would not finish eating meat inside the camera, he quickly gulped it when just outside the camera in the experimental room.

Externally, his behavior during this period of daily feeding in the camera varied from being somewhat quieter than he had been to agitation and hyperactivity, equal or greater than that seen before 1936.

The description of the behavior on the days noted below is typical and includes the appearance of new symptoms. On 20 October can be seen the difference in his reaction to H.S., who worked with him most closely, and to W.H.G. Frequently therafter it was noted that he was more friendly towards strangers than toward those with whom he was more closely associated. On this day the unusual rapid panting and hoarse breathing broken with intervals of quiet breathing were pronounced. He grovelled about the feet of W.H.G., but retreated from H.S. He ran quickly into the camera without coaxing, jumped on the table and began eating the meat but stopped abruptly as soon as H.S. placed his hand on the leash as if to tie him. Attaching the collar caused him to stop eating for a few moments, after which he started up again rather readily.

On 28 October, 1936, the presence of another male dog, Billy, tied in the experimental room with him seemed to increase Nick's agitation. This factor should be taken into consideration in comparing the effect of the presence of human beings and of female dogs as

noted later. He ate his full pan of meat on this day very excitedly, dashing in and out of the camera, fumbling with his biscuit on the floor outside. Brought down three hours later, Billy was no longer in this room, Nick was quiet, ate the ovals without coaxing, although had been previously fed in the morning. On this day an important characteristic of his behavior appeared—he reacted to the past rather than to the reality of the present. When a tone was sounded Nick began to whine as he had before, and instead of looking toward the source of the tone he looked fixedly in the opposite direction, in that corner of the room whence the tone had previously come and *backed away from the old location of the tone but actually toward its present position.*

On 4 November when he was very excited, as soon as he was unleashed he ran away from H.S. and jumped up on W.H.G.

During October and November hyperactivity was prominent even outside the experimental environment, i.e., there was excessive running in the paddock for the 24 hour period.

On 27 November, 1936, under the stimulation of a dog in estrus in the antecamera, he exhibited normal sexual activity. There was at this time no effect of the sexual excitation on his general condition.

On 10 December, 1936, frequent *micturition* in the experimental room again appeared. On this day he ate purina biscuit on the stand, but refused them after the leash was on. He was fairly quiet until the tone was given, during which he retreated (from the imaginary location), whining, and when brought out into the surrounding room he urinated in several places in the room. He acted aggressively toward Billy, who was in the room, bristling, but when Billy approached him, he crouched passively, rolled on his back, and when Billy snapped at him, Nick ran under the table.

On 15 December, 1936, the effect of the tone on the food reflex was tried. Nick when brought down dashed frantically into the camera, jumped on the stand and dashed out. At 13:30-31 he ate from a pan of meat, continuing while the leash was on. At 13:32 a tone of 1000 cycles was given for 30 seconds. As usual, Nick backed away from the place where the tone was *formerly* located, still looking intently in that corner. Offered the meat again at 13:33 he would not eat though the pan was brought under his nose. He resumed eating at 13:38. At 13:40 a tone of a different pitch (T500) caused the same reaction as T1000. At 13:40-41 Nick ate the meat ravenously in the camera. Here was seen the inhibitory effect of the specific tone, and also of other tones which had not been used, in inhibiting the food cr even to meat when Nick was hungry.

Outside the camera on that day Nick alternately grovelled around the experimenter's feet or exhibited an erect aggressive reaction, with hair bristling, towards objects in the room on which he urinated many times, immediately going from one object to the other in spite of being whipped for so doing. En route to the experimental room he urinated several times in the elevator and in the corridors.

On 16 December, 1936, during a demonstration of this animal before several people, we saw the reciprocal relations between the sexual reflexes and the anxiety state elicited by the tone. Brought down at 15:00 he was hyperactive, running in and out of the camera, refusing to remain inside unless coaxed. At that time there was a female in estrus in the room who had been given a convulsion by electrical shock resulting in expulsion of urine

the bladder. Nick became intensely interested in this pool of urine, sniffing over it and lapping it up. When T1000 was given during this procedure Nick paid no attention to the tone, but continued to sniff the urine. At 15:15 he took meat outside of the camera after coaxing; but did not take it inside. When T1000 or T500 was given he stopped eating immediately, slinking away and then running slowly, though he was already outside the camera and separated some distance from the source of the tone. When T1000 was given with Nick inside the camera, he gave the typical reaction of looking in the corner, retreating and whining, paying no attention to food in the pan under his nose. At 15:20 a female dog was brought into the camera close to Nick, whose external genitalia he sniffed. T1000 given for 1½ minutes after he had begun to sniff the female was without effect on him—he gave none of the anxiety reactions to the tone but continued sniffing. As soon as the female was removed he began to react as usual to the tone. The failure of the tone to inhibit the sexual behavior toward the female or toward the urine, while the tone readily inhibited the food reflex even while the food was in the mouth, was evidence of the greater intensity of the sexual reflex at this time compared with the food reflex.

At 15:30 Nick began urinating in the room and by 15:45 he was urinating almost every minute on some object. When brought out of the camera Nick assumed an aggressive masculine attitude toward the female dogs, holding his head and ears up, trying to mount them; but he was easily cowed, crouching at the raising of my hand over him.

During the next few days (through 21 December) Nick was very agitated, refusing to eat meat in the camera, but looking in the corner where the audiometer used to be, occasionally backing away from this place. Frequent micturition was a feature on these days—11 times in the antecamera on 17 December, 12 times 18 December, 6 times 21 December, i.e., nearly once every minute. On the 18th he appeared more excited when someone entered the camera, which had been noted occasionally previously. Inside the camera he licked at the meat but refused to eat it, though when it was put on the floor of the antecamera Nick took it intermittently, hesitating some moments before grabbing at the next morsel. He rushed around the room frantically, jumping up on W.H.G. but avoiding H.S. On the 21st he was slightly less agitated and ate a full pan of meat in the camera at intervals.

Having noted the inhibitory effect of sexual stimulation on the appearance of the anxiety reactions to the tone and its milieu, on 22 December, 1936, at 10:30 a small dog in estrus was put into the paddock with Nick. Coitus followed immediately. At 13:30 Nick was brought into the antecamera for observations. He was markedly more quiet than he had been for some time; also he ran into the camera without coaxing, and ate a pan of meat. There was no urination in the experimental room. The little female was left in the cage with Nick until 5 January, 1937. During this whole period, when Nick was brought down into the experimental room, he was much quieter, there was less hyperactivity in running, he went into the camera more readily, ate the meat then without hesitation and urinated only twice in the antecamera during the three month period. On December 31 we noted for the first time in several years that Nick did not pant nor breathe raucously in the camera.

1937

On 5 January, 1937, after the female had been removed from Nick's paddock the effect of the tone was tried again in order to see what improvement had resulted from the feeding

in the camera and particularly the presence of the female with him. The tone was given for 10 seconds; during the first two seconds he continued eating, then stopped, returned to the food after one minute ate a little and then stopped again. After this he would not eat for 15 minutes even when coaxed by W.H.G. Unleashed, he ran out of the camera and dashed around the room for about 30 seconds, running back into the camera and eating very rapidly. When the meat was taken away for 5 seconds, Nick finished it quickly when it was returned.

Nick was decidedly improved on this day—he reacted to the tone, showing less "anxiety" than he had for several years. There was considerably less hyperactivity in the camera, where he was comparatively quiet. He ate the full pan of meat every day for several months in the camera, and sometimes took Spratts ovals from the food box. Panting was diminished or absent, he usually went into the camera without coaxing and there was practically no urination in the antecamera. This improvement continued until 31 March, 1937. Inasmuch as neither rest nor feeding of meat in the camera had much effect upon the behavior of Nick, it seems justifiable to conclude that the companionship of the female in his paddock was responsible for this striking improvement. Further evidence in favor of this view is the previously demonstrated inhibiting of the anxiety by strong sexual stimulation.

The purpose of the above note is not for evaluation of the role of sexual stimulation in anxiety, as the data of this experiment were not designed to this end, but simply to point out the reciprocal relations that exist between sexual excitation and the anxiety-like state in the animal.

The 24 hour *activity curves* for this period show that he was much quieter after being with the dog in estrus.

The subsequent observations in Nick show that after removal of this dog from his paddock he gradually returned to his former state of agitation and "anxiety" in the experimental environment.

On 31 March, 1937, the effect of the tone was again tried. In the presence of visitors he was hyperactive, running violently and panting. In keeping with his past behavior, he was much more friendly with the visitors than he was with H.S. who usually worked with him and whom he avoided. Outside the camera he eagerly ate the Spratts ovals, when they were thrown on the floor in the camera, or on the table and even from the food box, though he refused to take the food after the leash was attached unless coaxed; even when introduced into the mouth, he rejected the Spratts ovals, though he ate the meat readily. Loud raucous panting occurred in the camera. When the ovals were dropped from the shelf into the food box, as they were routinely during his training, Nick looked down toward the *former* position of the tone for a moment and started whining even though the tone was not given, and had not come from that position since 1934. He would not take even the meat for 30 seconds after dropping of the ovals, which as usual he refused. It was thus apparent that not only the tone but many other elements in the environment in which it was given had become equivalent to the tone in producing the anxiety. The reverse process of differentiation has occurred in this dog; instead of a progressive adaptation to a specific stimulus as occurs normally, a *pathological generalization* has occurred so that any stimulus occurring in the environment can now call out the anxiety state. The tone was turned on at 15:15, using a very low intensity, and continued until 15:21. During its action the dog would not take the meat

(at 15:20) nor even after it (at 15:22); however, when some of the meat was put into his mouth at this time, he ate it; given meat at 15:23 he took it readily; but ceased eating immediately when the tone was turned on at 15:26½, stopped his rapid breathing and panting to take 3 or 4 long deep inspirations. Although the tone was on for only 15 seconds he still refused to eat the meat two minutes later at 15:28; at 15:29 he would not eat the meat from the pan but did if it were introduced into his mouth. Even when the tone was very faint, Nick assumed his usual posture, whined slightly and started his characteristic slow deep respiration shown in the graph (see Ch. VI, section 3). At 15:35 Nick was coaxed to eat by putting meat into his mouth after which he began eating out of the pan, but when the tone was started at 15:35½ he stopped eating and spewed the food out of his mouth, standing with tucked tail. When at 15:39 for two minutes the tone was turned up from faint to loud he again changed his rate of breathing, started whining and backed off. One minute later there was forced and markedly raucous breathing and retching. The effect of the tone on changing the respiration and inhibiting the food reflexes continued for several minutes after the tone was cut off; he rejected the food even when it was put into his mouth at 15:42. The salivary disc was removed at 15:47. On first coming out of the camera he did not eat the meat, although he took it after two minutes. When the tone was turned on inside the camera at 15:49, although the dog was outside and about 10 feet away, he dropped the meat he had in his mouth, and slunk about the room in a crouching position. Later he ran into the camera, jumping on the table then down quickly, eating ovals from the floor and out of the pan. There was no urination in the antecamera on this day.

From this and other similar experiments it is evident that there is a definite spatial and temporal relation between the action of the tone and the behavior of the dog: the effect of the tone diminishes directly with the distance it is from the dog, as well as with the elapsed interval of time.

The above examination on 31 March shows that although there had been an improvement in Nick the tone was still an effective inhibitor of the food reflex, producing in its stead defense reflexes.

When tested again on 9 April Nick was fairly excited and hyperactive. He ate in the camera until put on the leash, then he stopped, though he continued eating when fed from the hand and also ate from the food box. When T1000 was given for 1 minute Nick stopped eating immediately, whined and looked toward the place whence the tone originally came. He would not eat for 10 minutes after the tone even though coaxed, but he began eating when taken out of the camera, slowing up as soon as the tone was given but not completely stopping unless he was brought near the door of the camera. While the tone was on (inside the camera), he would not stay in the camera. About 1 minute after cessation of the tone Nick started eating.

It was noted that the typical loud breathing suggesting asthma occurred in Nick not only in the experimental rooms but when anyone who worked with him approached his paddock. On 20 May, 1937, Nick was fairly quiet when brought into the antecamera, though he began to pant loudly when approached by W.H.G. As noted previously, he ate in the camera until put on the leash. Reaction to the tone that day was the typical one. In order to determine the spread to other neutral stimuli, a metronome and a bell were given separately. To these he

reacted exactly the same as to the tone and in addition there was a sexual erection to the metronome.

An attempt was made to determine how far the pathological generalization had spread and whether it involved other analyzers besides the auditory. As the dog had never been conditioned to any visual stimuli, a flashing light was tried on 9 April, 1937; it produced at first no reaction except the orienting, which is a natural response to any new stimulus. However on repeating it several times 5 seconds before the tone and 5 seconds simultaneously with the tone, the tone lasting for 10 seconds, on the 8th trial the light acquired the same value as the tone in producing the defense reaction. The effect of the light was tried on subsequent days; it was seen to be not so stable as the tone and auditory stimuli, becoming fairly easily extinguished but quickly re-acquiring the ability to produce anxiety by repetition several times with any of the auditory stimuli. Thus on 20 May, 1937, the flashing light when first used produced only the orienting reflex, although on that day the bell and metronome were equivalent to the tone. It is evident from looking at the respiratory curves (fig. 9) that the light has nearly the same effect as the auditory stimuli, not only on the behavior but upon the movements of respiration. (See Ch. VI, section 3.)

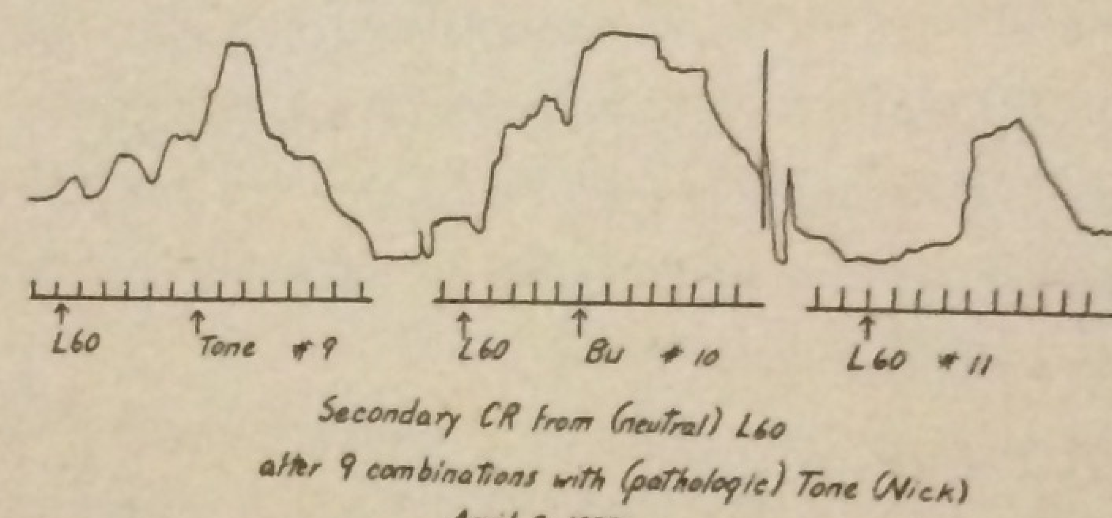


FIG. 9.

As I have pointed out, subsequent to the period of the routine experiments using conflicting stimuli, and for several years later there arose, as it were spontaneously, other neuroses, indicating a spread of the pathological state to involve new physiological systems. At first there were acute defense reactions to the specific csi, then to closely related stimuli within the same analyzer, and finally defense responses to any cs occurring in the experimental milieu. Next, permanent neurotic patterns were elaborated in physiological systems not previously affected. The respiratory and urinary neuroses have been mentioned. About this period there appeared a *stereotyped involvement of another system—the sexual*. The sexual symptoms took their place in prominence, intensity, and perverse stability along with the respiratory and urinary symptoms. Moreover reciprocal relations existed, one side of which have been noted in the effect of the female in estrus on the defense reflexes, and now the other side of the reciprocity appears, i.e., the power of the anxiety state to elicit sexual erections.

These urinary, sexual and respiratory neuroses lasted with some intermissions during the next five years.

The reciprocal relations between the anxiety-like state and sexual excitation were clearly brought out in a series of experiments, to be described in more detail later. This relation is apparent from the experiments of 10 June, 1937, when it is seen that sexual erections accompanied the anxiety, quickly appearing to the tone, and that on the other hand after normally produced sexual excitation, there is a latent period of 10 to 20 minutes after the onset of the excitation during which the stimuli that had habitually elicited anxiety were completely ineffectual. This refractory period following sexual excitation—during which the animal is immune from the anxiety—passes off gradually. Thus 1 minute after the onset

of sexual excitation there is no reaction whatever to the tone; 6 minutes afterwards the dog orients by turning his head but does not shift his position; after an interval of 13 minutes there is only a slight defense reaction; and after 42 minutes the tone brings out a moderately strong defense with slight whining (fig. 43).

The reciprocal relations noted above were seen in the same stereotyped form so many times subsequently that they could be demonstrated at will.

"Today as well as on previous occasions Nick was seen to react defensively when I tell H.S. 'All right Harry, give it' (referring to T). Nick also gives very slight defense (orientation with lifting ears and backing slightly) to a faint T from three rooms farther up hall (doors closed)." (Note in June, 1937)

Nick was used for a comparative study of the effect of the experimental environment of the anxiety on normal sexual excitation from June until August 1937. The results of these experiments will be outlined separately in the next chapter.

In order to determine the effect of a complete change of environment, it was decided to remove Nick not only from the laboratory but to give him a life of less restriction on a farm. Previous attempts to convert the laboratory environment—by rest, cessation of the experiments, and substituting for the conflict a strong food excitation (eating all of his daily food in the experimental camera)—had only a slight ameliorating effect. Accordingly, 1 August, 1937 he was transported by train 200 miles out of Baltimore to my farm in Virginia where he remained until 3 October, 1937, when he was returned to the laboratory in Baltimore.

On first arriving in the country he showed in a marked degree his antipathy toward people who had been associated with him in the experimental environment. To these he reacted as he had to a neutral stimulus such as a light which had concurred simultaneously with the tone. Thus when I met him at the station and led him up the road, instead of running to me as most dogs who have been separated from people they know are accustomed to do, he paid absolutely no attention to my calling him and to other friendly gestures, but gave even a negative reaction, turning his head in the opposite direction and strongly attempting to pull away. Towards strangers he was much more friendly, a characteristic of his even to 1943. After several days in the country he became less negative toward me, barking and jumping up on me when I approached. Most of the time while there he was kept on a forty foot chain. Jealousy of other dogs seemed to bring out the anxiety state; thus when another dog was brought into the "family" on 7 August Nick became much more agitated, running and barking furiously, showing behavior noted by several people as extraordinary.

Toward the food that he had received during the experiments in Baltimore (Spratts ovals) he reacted for the first few days in the same way as he did in the experimental camera, picking them up and dropping them. Afterwards he ate them readily, though in 1939 they produced the anxiety-like state again, as will be described later.

Toward a new dog he acted aggressively as he had done in the laboratory, bristling his mane, without however coming to the point of fighting.

He did not know how to swim when first brought to the farm, though he learned soon after being put into the water. On three occasions he had disagreeable experiences—once when thrown into the water, the second time when he became entangled in his chain which bound him tightly where I had left him tied, and on a third time when leashed to the back

of my bicycle his foot got in the chain and he was dragged for some distance. After each of these he appeared less friendly toward me for several days, showing the behavior previously seen in the laboratory. When taken for a walk after these experiences there was restlessness and pollakiuria (every two or three minutes, though only a few drops) accompanied by vigorous scratching with all 4 feet, growling, and penile erections. The effect of these painful experiences and the laboratory environment were very similar, though the latter lasted longer and was much more severe.

On 3 October, 1937, he was returned, having trotted 6 miles and walked 4 more to the station behind my bicycle. During this journey he became quite excited, lay down and would not go further without rest as his foot was bleeding from a stone cut. Apparently there was no ill effect from this exhausting journey. This is in keeping with my previous findings—painful experiences *per se* are much less powerful as a cause of disturbed behavior than an emotional disturbance or "conflict," and indeed they may leave no trace of their effect on the nervous system as measured in the crs, while a conflict of only a few seconds' duration may have an effect for days.

He was left overnight with strangers, and shipped the next day by train to Baltimore. In spite of this fatiguing episode and being in strange quarters, his behavior when returned showed a marked improvement. Whether this was a result of the beneficial effects of the rest, or whether because he did not associate his fatigue with me, as he had previously associated other disagreeable incidents in which I was more intimately involved, could not be determined.

When returned to the laboratory on 5 October, 1937, he ran willingly into the camera and jumped on the stand. He ate outside but not inside the camera. While he was outside the tone had little effect on him, neither upon his eating nor did it make him whine as it previously had.

There was no urination in the experimental room, though there was a slight erection. A specific defense cr was present, as had been previously and regularly seen to my order to H.S., "All right Harry, turn on the tone." The cr movements consisted in slight restlessness and whining but not so much as formerly. On this day there was definitely less restlessness, less fawning, and none of the peculiar raucous breathing (except very briefly) noted when he was last in the laboratory.

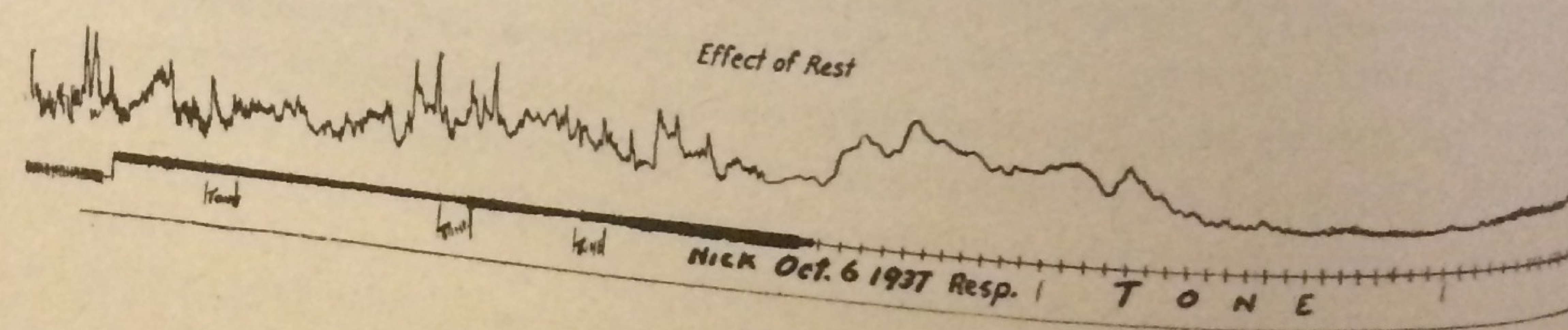


FIG. 10.

His behavior continued to be much more normal during the next month. Thus on the 6, 8, 13, 14, 19 October and until 11 November he was relatively quiet in the experimental room and camera—to the tone there was only slight whining, a brief period of panting and less retreating. An examination of his respiratory record shows that the tone had very

little effect upon his breathing movements on 6 October, 1937 (fig. 10). All those familiar with Nick agreed from his overt behavior that he was markedly improved. The fact that this improvement lasted over a month suggests that it was due to the rest rather than to the shock of the exhaustion during his running to the station.

On 14 October, 1937, in the experimental rooms he was somewhat more restless than he had been on the 5th and 6th. During the tone he looked anxiously to the floor toward the old location of the tone, urinated twice in the camera and had a slight sexual erection (figs. 11, 12).

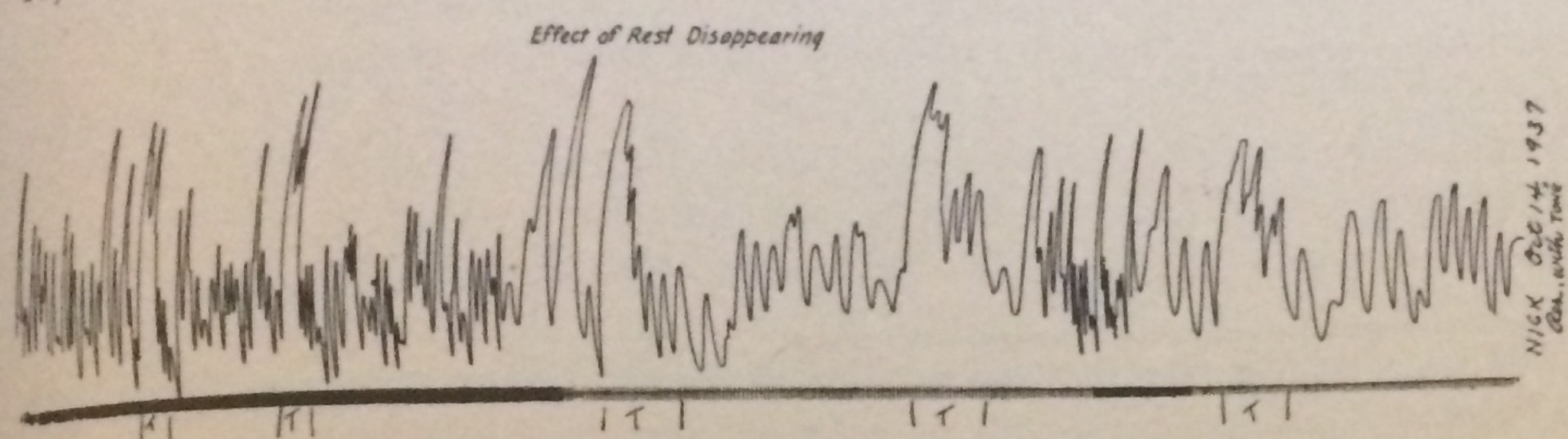


FIG. 11.

On 11 November in the paddock Nick was quiet and ate the ovals. When brought into the experimental room he showed the same violent, raucous breathing, was very restless, and would not eat. He dashed in and out of the camera. There was a marked state of anxiety to the tone with increased respiratory rate. Sexual erections began when he was taken into the camera and increased during the time of the tone, lasting altogether 10 minutes.

1938

The effect of the tone was tried on 3 January, 1938, and again on 12 January. On the latter day the ovals held in front of the snout showed that there was inhibition of the natural food reflex to the sight and smell of the food, as no saliva flowed from the salivary fistula, although there were a few drops when the crackers were forced into the mouth. This is evidence of the deep inhibition caused by the environment. Not only were the artificial food csi inhibited, but also those older and stronger ones dating from early puppyhood associated with the sight and smell of the food. However the salivary UR was not abolished (Table 24). The second time on this day that the tone was given there was much more marked reaction than there was for the first time—retreating, whining, sexual erection.

On this day experiments were done to show the effect of the *social factor* on the anxiety. Although it had been previously noted that the approach of a person who had worked with the dog would often bring on the raucous breathing and other pathological symptoms, conversely we saw that standing close to the animal and more particularly stroking and petting him prevented or dissipated the symptom of anxiety. Thus when I or either of two strangers (H.S., K.) petted the animal there was no reaction to the tone, but the tone tried alone on the same day gave the typical reactions—whining, dyspnea, retreating, erection (fig. 12).

On 14 January, 1938, Nick would not eat in the experimental room nor in the camera.

An aggressive bulldog (Billy) was present with him, which probably caused him to his tail while on the stand. That the dissipation of the defense reactions did not result from the diversion of an extraneous stimulus (external inhibition) was shown by the trasting effect of the dog Billy and that of the human being; the anxiety was abolished my petting the animal (fig. 12) but was not changed by the presence of another dog, tied in there with him. See the respiration record for 14 January (fig. 13).

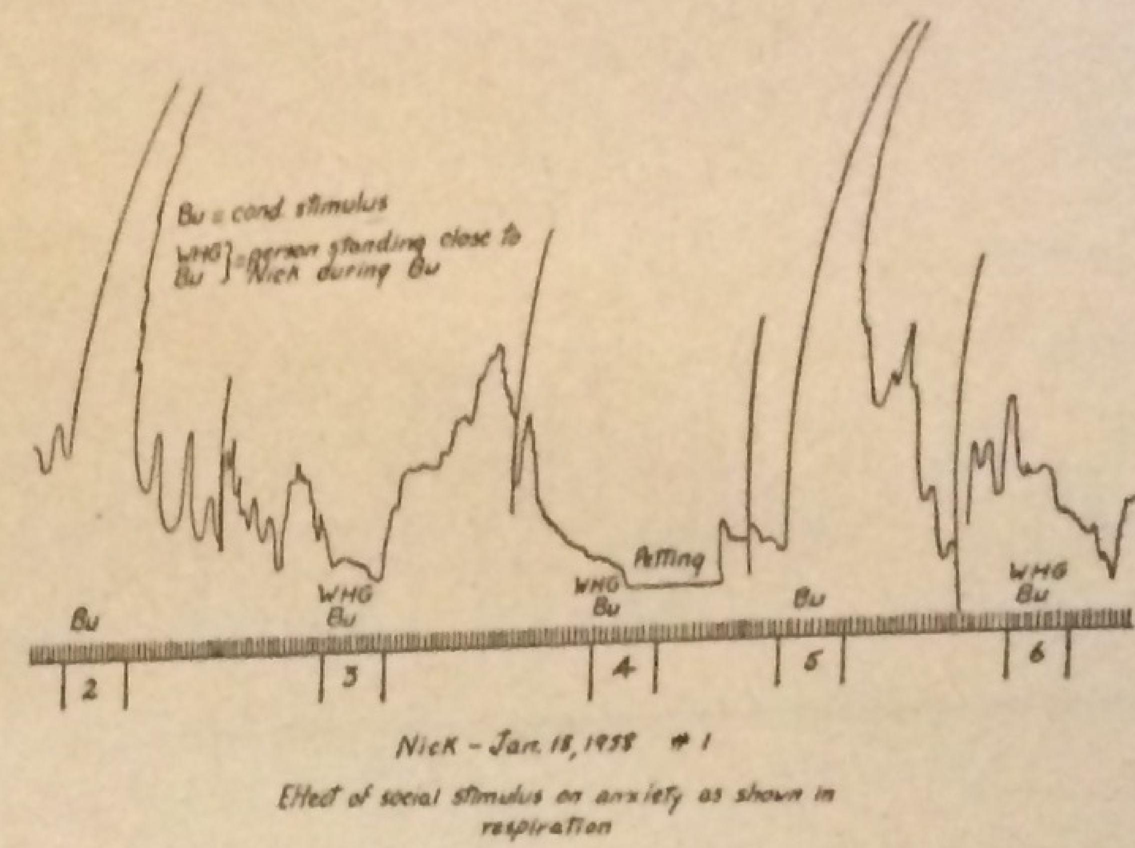


FIG. 12.

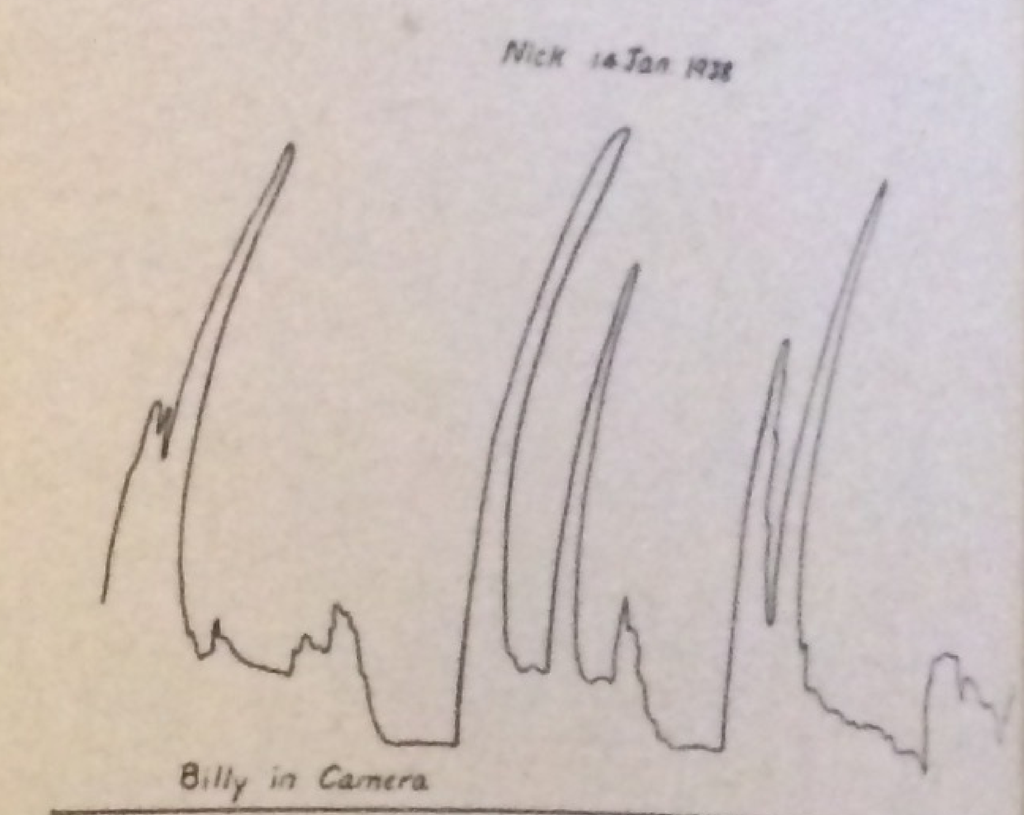


FIG. 13. Lack of effect of another dog on conflict in Nick: compare effect of human being (figs. 11 and 33).

On 17 January the effect of petting the animal—rubbing him behind his ears begun two seconds before the tone—quieted the animal so that there was absolutely no reaction to the tone, i.e., no disturbed breathing or movement until he left the camera, nor were there erections while the dog was in the camera. When the ovals were held under the dog's nose for one minute he refused them, turning his head away, and started panting.

On 18 January he would not eat outside of the camera in the experimental room; he dashed rapidly in and out. It was seen that other auditory stimuli such as M60, air bubbling through water, gave the identical anxiety-like reactions as did the tone of 1000 cycles. Again the presence of W.H.G. or H.S. in the camera with the animal markedly diminished the defense reactions; they were also more intense when the door was closed and the dog left alone (figs. 12, 33 and 44).

On 19 January I demonstrated the effect of another dog, Lucy, put into the camera with Nick. An examination of the record shows that, in contrast to the presence of a human being, this other dog had no quieting effect upon him. Lucy was the same dog which when in estrus some months previously had a markedly calming influence upon Nick but now had absolutely no effect—comparable to the neutral effect of a male dog Billy placed in the camera with Nick on 14 January (see respiration record for that day, fig. 13).

The effect of the light associated with the auditory stimulus, as noted before, resulted in an anxiety-like reaction beginning about 3 seconds after the light was turned on and 2 seconds before the tone. (The light was given 5 seconds before the tone and then 5 seconds together with the tone.)

On 7 April when the salivary disc was applied—the first time for several months—Nick jerked his head away, tucked his tail and went into marked tremors, especially of the hind legs. The disc represented an added stimulus from the previous experiment of conflict. When

taken outside the camera, at first he would not eat Spratts ovals although he took them after a few minutes.

On this day, at the beginning of the experimentation Nick showed the same retention of the conditioned anxiety-like movements to the light, and the anxiety became intensified to each repetition of the light.

On 13 April, when there were visitors and two other dogs in the room, Nick was slightly aggressive toward the dogs, sniffing at them and bristling up, growling but not fighting. He urinated 3 times in the experimental room during the first few moments; he showed exaggerated activity, dashing in and out. In the first 10 minutes that he was in the camera there were definite spontaneous erections lasting a few minutes each and associated particularly with the csi.

From 17 May, 1938, artificial sexual reflexes were measured and for the following year experiments were conducted to study the effect of alcohol on the sexual reflexes. These results are summarized in another place (*40*) (fig. 48); here I shall note only marked deviations in his behavior.

When 32 cc. of 95% alcohol (2 cc./kgm) were given in a 20% solution on 17 May, Nick became ataxic, falling over backward when he attempted to sit. His behavior was moderately slowed by being "drunk" in the camera; he ate readily from the hand and even took food from the shelf and food box while he was on the stand, which he had rarely ever done, but he did not eat after being put on the leash. For an hour and 15 minutes after the alcohol he would not eat either inside or outside the camera. The alcohol either increased the food excitability or diminished the anxiety state, but it did not remove the anxiety to the tone itself. Also the same quieting effect of petting the animal during the metronome was seen as it was on control days. On 19 May Nick was much calmer than usual; he ate from the floor of the camera until he was put on the leash—possibly the effect of the alcohol two days before. Also on the 23d Nick was markedly quiet, giving only a slight reaction to M60 and other auditory csi without whining or barking. Sexual excitability moreover seemed to be increased on this day, for the induced erection was extreme and lasted 14½ minutes—much longer than ordinarily. On the 25th the behavior was similar with an erection lasting 13½ minutes; on the 27th lasting 16½ minutes. On 30 May were observed spontaneous erections, raucous breathing and some anxiety-like reactions.

During June and July Nick was brought down about 3 times a week for the study of induced sexual erections and alcohol. The duration of these erections was 3 and 4 times longer than they had ever been before, i.e., from 10 to 18 minutes. The next dose of alcohol was given on 20 June. As Nick would not drink the 20% alcohol it had to be given by stomach tube. Similar to what happened with the first dose of alcohol, he ate in the camera and from the food box, and jumped up on the stand readily, looking for food. There was also no anxiety-like reaction to the tone, and on this day the alcohol seemed to abolish completely the defense reactions to the tone.

Sometimes in Nick a sexual cr (erection) was noted when he first entered the camera and jumped upon the table. This was apparently conditioned to the procedure of inducing the erections rather than a component of the anxiety state. In some other dogs used as control it was, however, impossible to form sexual crs to the procedure that we used.

It is highly significant that the sexual reflex conditioned to our procedure of direct peripheral excitation was much shorter in duration and *less intense than the sexual reflex which was part of the emotional state* of the "neurosis."

Sometimes Nick could be coaxed to drink alcohol diluted to 25% with milk, but he usually refused it.

One cc./kgm of alcohol gave no visible effect on his behavior. The effect on the sexual reflexes are noted separately in Ch. VI, section 6.

From 22 July, 1938, until 21 October, 1938, there was no experimentation. On [illegible] October 3 months after his last dose of alcohol, he again became agitated. There was the same raucous breathing, and although he ate in the antecamera he would not eat inside the camera even before the leash was attached. To the metronome, tone, bell, and bubbling, there were defense reactions, but these were very slight. Nick was, in general, a little quieter than usual. The same fetid odor was noted, however, with Nick in the camera as was observed when he was particularly disturbed.

On 2 December, 1938, Nick ate both outside and inside the camera until the bell was given; after this there was an erection, refusal to eat, raucous breathing, etc. Later on in the experiment an erection occurred to an extraneous auditory stimulus (click of a switch). Also to the light there were defense reactions with sexual erection lasting 30 seconds. Again on the 8th trial of the tone, sexual erections and defense reactions were noted.

On 30 December when Nick was brought down he was hyperactive as usual though he ate the crackers even inside the camera on the stand. The tone elicited a sexual erection and defense reactions; these appeared to every auditory cs and in a slighter degree to the light. Even when a collaborator (Löwenbach) whistled while the dog was eating the food in the experimental room, he dropped the food out of his mouth during the whistling; this occurred mechanically each of 5 times that it was tried. The defense reactions to the tone were dissipated by the petting of a visitor (M.R.) as well as that of W.H.G.

1939

On 11 January, 1939, Nick showed increased anxiety and raucous breathing as he was brought down toward the experimental room, although when observed immediately before in the paddock, he was quiet. Inside the camera he ate until the leash was attached. That it was the *leash plus the environment* which stops the eating was shown by his eating while on the leash outside of the camera *if* he was fed from the hand of strangers (Drs. Alexander, Leighton, Rich) neither of whom he had seen before, but he refused to eat from my hand or that of J.S., the brother of H.S. who ordinarily worked with him (J.S. is a technician on another floor in the Medical School).[20]

In addition Nick would not eat from the hand of a collaborator (H.S.). This behavior is parallel to his running to visitors in the laboratory in preference to those who work with him, and his marked avoidance of me when first taken to the country in 1937. Such behavior in Nick was demonstrable repeatedly.

On 13 January, 1939, Nick showed the same stereotyped anxiety and defense reactions

[20] This is probably family association, for I noted that Nick reacted similarly to members of my family while in Virginia. It may be based on olfactory family resemblances.

unaffected by the presence of several strangers and the apparatus and lights used in making a cinema of him.

When brought on the morning of 29 March, he urinated in the antecamera 3 times. His heart rate was accelerated, showing the effect of the presence of someone with him; it varied from 128, while I was standing by him in the camera, to 192 immediately after the bell. Sexual erections were elicited by the old food csi.

During April, May and June, experiments designed to elaborate a sexual cr as well as a continuation of the study of the effect of alcohol were performed.

On 19 April the increase in heart rate on entering the camera was about equal to that on hearing the tone; the rate quickly returned to normal when the tone stopped. There was only a slight increase in heart rate to the bell (a cs for the sexual reflex) and also only a slight increase during ejaculation—these increases are much less than those accompanying the anxiety state.

On 6 May the behavior of Nick was contrasted during a demonstration with him of a normal dog ("Billy") who had also worked about the same length of time in the experimental camera. "In their paddocks at 10:20 both are lying down quietly. Nick immediately starts the forced raucous breathing when taken out of the paddock, he runs first to the strangers, while Billy runs first to me; Billy takes meat from my hand, while Nick runs around in circles panting. When brought down on the elevator this raucous breathing continues. When the tone was tried at 10:26 for 30 seconds, Billy gives it no attention and continues to eat, while Nick drops the biscuit from his mouth, urinating during the tone and twice again within the next two minutes; 5 minutes after the tone he begins eating again. At 10:31 Billy runs in and jumps on the table in the camera while Nick dashes in and out many times. At 10:33 when Nick is on the leash he refuses food. At 10:34 while the tone is given with Nick in the camera, there are marked defense reactions—backing away from the *former* position of the tone, appearance of erection in 10 seconds after the beginning of the tone (the erection lasts for 4 minutes, the penis being protruded about 9 cm.), rapid panting." None of these symptoms were seen in Billy.

On 11 May when Billy and Nick were brought into the experimental room together again for demonstration practically the same behavior occurred as on the 6th. On this day it was noted that Nick gave not only the spontaneous erection to the tone but both the spontaneous erection and the typical defense reactions to a verbal signal—when I told the laboratory assistant, as I had done frequently, "Go ahead Harry give the tone." On this day the erection to the tone for 10 seconds lasted about 2 minutes. Both the erection and the defense reactions disappeared when either I or a stranger (W.H.) were standing by and petting the dog. One minute later when the tone was given in the absence of a human companion, Nick gave the typical reactions—defense movements and spontaneous erection—although another dog, Billy, was in the camera only 2 feet from Nick's head. It is thus evident that the human companion, when he is petting Nick, has a specific relationship in dissipating the anxiety. The human, contrariwise, is a factor in the initiation of the anxiety. The effect of a female dog in estrus had a similar quieting, though more prolonged, influence on Nick, while the same female out of estrus or a male dog was entirely without effect upon Nick.

On 26 May it was noted again that the bell which had been used as a cs for the induced

sexual reflexes for some months every other day or less frequently, now gave the cr erection 30 seconds after the beginning of the bell. This erection was slight, however (lasting only 15 seconds), in strong contrast to the erections (lasting for several minutes) which were a component of the anxiety state. On 26 May Billy and Nick were again contrasted in the camera with the same results as noted above, viz., Billy eating voraciously under all conditions and Nick stopping immediately when the tone was given even though he was running free in the antecamera. During the first 5 minutes that Nick was brought down he urinated 3 times on the leg of the table in the camera; Billy never urinated in the camera.

On 3 June again, Nick was seen lying quietly in the paddock until someone approached him when he began the peculiar type of respiration. His preference for strangers was again demonstrated by his running to Dr. Ischlondsky, a visitor, instead of to those who had worked with him. He urinated 6 times in the camera on the table leg. There was a very light erection when the door of the camera was left open but a marked erection with the door shut (isolated from his human companions).

On 8 June Nick urinated twice the first minute he was in the antecamera. While another dog was in the camera and Nick was running free outside, some distance from the tone, there was evoked by the tone a marked erection with protrusion of the penis for about 10 cm.; however, 7 minutes later absolutely no cr erection to the bell occurred, again demonstrating the predominance of the sexual erection accompanying the psychopathological state over that which was conditioned directly in the ordinary manner of forming artificial crs. On June 9, when brought down for demonstration, Nick urinated 5 times in the first 4 minutes he was in the experimental room, stopped eating to the tone, ran and jumped on Dr. Kluever, a visitor, in preference to either the assistant H.S. or W.H.G.; there was an erection beginning 5 seconds after the onset of the tone and lasting for 100 seconds. He refused food inside the camera.

On 25 August, 1939, Nick was transported by train to the farm in Virginia. At 10:30 that morning in the antecamera his heart rate was 205. In the baggage room at the station he urinated 15 times during the 10 minute wait.

In Virginia on 28 August at 11:50 a.m. his heart rate was 110, and 5 minutes later 108. He was very active and panted slightly. On 27 and 28 August Nick showed great excitement toward a female in estrus—scratching the earth vigorously, kicking out his feet, urinating frequently on the ground where she had been lying. On 29 August his heart rate varied from 110 to 150. Although the dog appeared quiet externally when I approached, there was an increase in heart rate without external changes in the behavior.

On 11 September the heart rate varied from 97 to 113. It was seen at this time that Nick's learning capacity was acute, e.g., after twice striking against an electric fence wire he would not touch it again; when pulled that way, he nimbly hurdled it.

On 12 September the heart rate varied from 105 to 118 in the presence of humans, but reached 130 when a male bulldog growled aggressively and approached him to within 1 foot (they were held apart on leashes). Nick also growled somewhat. The second time that this bulldog was brought within 6 inches of Nick, the heart rate did not exceed 118.

On 28 September Nick's heart rate in the presence of human beings varied from 95-120. With a cat clawing his back it was only 100, while with the aggressive bulldog allowed almost

to touch him, his heart rate was 140 while he was bristling, though only 105 when they were standing close together unaggressively.

It is thus clear that the real danger, that of an aggressive bulldog, or the actual pain of being clawed by a cat, produced less excitement, judging both by external appearance and by the heart rate, than the laboratory situation involving "anxiety."

On 2 October, when taken off his leash and allowed to run, he became very excited, panting vigorously at times. It was observed on this day and on some other occasions that Nick ran close to some person when he defecated, spinning around rapidly and pivoting on his forefeet with marked erection (protrusion of the penis for about 10 cm.) lasting for two minutes.

On 19 December there was the typical noisy breathing when W.H.G. approached. Given 3 Spratts ovals—the same kind of food he had during the experiments in the laboratory —he took them in his mouth but dropped them without chewing, then became excited, running around in circles. When I dropped the biscuits in his food bucket he ran up to them, sniffed them, then immediately urinated on them 3 times within one minute. This urinating in the vessel from which he usually ate and upon food is an unknown act for a normal dog. Its significance will be discussed later. On 20 December at 9:38 a.m. his heart rate standing close to me was 140-150; 150-160 when offered the Spratts ovals and purina checkers. Nick was very restless on this day, turning on his back and struggling when the electrodes were attached. He urinated 3 times in the room when his heart rate was measured.

1940

During 1940 Nick was kept on leash most of the time on the farm, though during August he was allowed to run at will. He was cared for by a farm hand with whom he was very friendly. In July and August I was with Nick on the farm and fed him. He attempted to follow me everywhere. He was returned to the laboratory 14 January, 1941.

On 23 February, 1940, on a visit to Nick at 12:15 when he saw me coming he crouched, then lay on his back. An erection occurred when I was at a distance of about 100 feet; it lasted for 2 minutes with ejaculation for about 10 seconds. The heart rate during ejaculation was 140; 1 minute after, 80-120 (both times lying on his back). At 12:17 his heart rate was 75, still lying on his back. There was no urination during this morning observation. At 12:18 a measurement of the sexual reflexes was about the same as it had been in the laboratory (see fig. 43 and Table 27). At 15:30 Nick was quiet, there was no panting, the heart rate was 75. At 16:30 he was seen to urinate twice in his pail of water, an action which the attendant says he did frequently, but as pointed out, an unusual act for a normal dog.

On 14 March the heart rate was 90, Nick lying on his back. When I was near him there was a slight erection without ejaculation, lasting 60 seconds. His attitude toward me and toward the attendant was noticeably different: he crouched when he saw me, then rolled over on his back, while he jumped up on the attendant in a friendly manner.

The same contrast in his behavior was again seen on 30 March. At 15:00 with another farm hand who never fed him but sometimes saw him he was very friendly, climbing up on him with his forelegs. At 15:01 when I approached or touched him there was a marked erection, and he crouched on the ground at my feet. Again at 16:00 when I came near he crouched and there was an erection which became more pronounced when I patted him on

his side; the erection lasted over 1 minute. At 16:05 when the attendant patted him in the same way as I did Nick instead of crouching, climbed up on him with his forefeet, and there was no erection.

On 31 March at 11:00 with the attendant there was no erection and Nick climbed up on him with his forefeet as he did the day before. At 11:05 when I was standing near him, he sat at my feet then turned on his back. When I touched him on the side, an erection appeared within 2 seconds, lasting 30 seconds and accompanied by ejaculation for a few seconds.

On 5 May at 7:00 with the attendant patting him, Nick climbed up with his forefeet and there was no erection. At 7:02 when I stood near him he started to climb up on me then crouched and an erection began in about 5 seconds and lasted 1 minute. While I was patting him he turned over on his side. At 14:00 his behavior was identically the same with me as it had been in the morning. On this visit and on some others I observed that Nick barked and panted frequently; the attendant said he did not do this nearly so often as when I was not there.

On 12 May I arrived on the farm but did not approach Nick closely till 13 May at 10:00; Nick crouched when I went up and touched him, then started to jump on me, then rolled on his side, later on his back. There was a slight erection for a few seconds, with protrusion of the penis for about 3 cm. and ejaculation for 10 seconds while he was on his back. At 12:01 when I went up and touched him he vacillated between crawling up on me and turning on his back. At 12:05, when a member of my family (my four year old son) went up to Nick, there was also a slight erection, slight crouching and behavior intermediate between that toward me and toward the attendant. The only explanation that I could give (as Nick had never been closely associated with my little boy before) was that for some reason, perhaps olfactory, Nick associated him with me, as he had previously done another member of my family. At 12:10 Nick climbed up on the attendant in a friendly manner, there was no crouching and no erection, but immediately afterward Nick retreated from me a few steps.

On 20 May at 10:00, Nick panted loudly when I appeared, crouched, rolled on his back, got up then crouched again. He made a half attempt to climb up on me. An erection began when I approached him and continued without ejaculation for 4 minutes with protrusion of the penis for about 3 cm.

Sexual erections frequently appear in dogs in the spring or when they are excited, but the stereotyped manner in which it is seen in Nick and its appearance with specific people, in the light of Nick's previous history, undoubtedly is of another type and of greater significance than simply that of normal excitation or of normal sexual excitation. Erections are more general in young animals than those of Nick's age.

On 25 May when Nick heard me several hundred yards away he started barking and panting. An erection began when I was still 40 yards distant. As I went up to him he crouched slightly, turned on his back; there was a slight erection for 3 minutes with ejaculation. After subsidence of the erection Nick crawled up on me.

In a control young dog (King) whom I saw for the first time on 20 May there was a slight erection and crouching—evidently timidity or fear—but in this same dog who re-

mained there with Nick and was later brought to the laboratory, I never at any other time saw an erection, nor have erections appeared regularly in any of my normal dogs.

In August 1940 Nick appeared to be sexually potent. He frequently mounted for a period of 5 to 10 minutes the large male dog (King) about nine months of age, and he copulated repeatedly and effectively with a female dog in estrus; the puppies born resembled Nick.

After close association with me and being fed by me during the summer his attitude was markedly changed. There were never any erections when I went up to him, he climbed up on me instead of crouching, and his heart rate was 90-100. He devotedly followed me about, although the noisy panting was at times present. On 12 September his heart rate was 100-120. When he was allowed to run loose he was more restless and excitable than the other dogs, becoming quickly aggressive with them—bristling the hairs on his back but not fighting.

He liked to come into the dwelling house; there he would eat readily and even beg for food. When I whipped him for jumping on the table he grovelled at my feet, but there was no urination nor erection for the 30 minutes he was in the house, and he urinated only 3 or 4 times during 2 hours while running with me over the farm. His friendly attitude was in marked contrast to the negativism he exhibited toward me when he was first brought down to the country, and also very different from his attitude at the beginning of the summer. Especially noteworthy were the absence of pollakiuria and sexual erections, but the hyperactivity and the slight raucous breathing remained.

On 13 September, after his morning feeding at 8:55 I brought him into the same room with me for 35 minutes. His heart rate while there was 90-110. He climbed up on me occasionally but lay quietly the rest of the time. Panting was quite frequent but there were no erections. He attempted to urinate twice—at 9:15 and 9:28—but was easily checked each time. On 16 September, after running loose for several weeks, he was seen fighting with a one year male pointer (King) and attempted copulation with a small 4 year male. At this time it was noted that he could keep up with me driving the automobile at the rate of 16 miles per hour for a distance of three quarters of a mile. On 17 September he lay quietly by my chair in the house, showing no restlessness, panting or urination. On 18 September he was seen to urinate twice on a visitor's (J.D.P.'s) luggage, but in contrast to his behavior in the laboratory, he was easily checked by a remonstrance and he did not urinate elsewhere. He appeared sexually hyperactive and mounted on this day a female French poodle (not in estrus) belonging to the visitor on whose luggage he urinated. Nick was rather aggressive in these sexual overtures and he was attacked by the poodle. This suggests aggression toward the intrusion of the strangers after he had become attached to me; the action of the poodle was a natural female defense.

His devotion at this time was more marked than that of two of my other dogs on the farm; he would follow me nearly everywhere, jumping into the car or running after it. His behavior with other dogs was not quite normal—he would either be aggressive toward them or attempt to copulate, and was often seen fighting with other dogs. This can be compared with the behavior noted in 1933 when he remained aloof from other dogs in the paddock.

On 12 October at 7:30, when H.S. who formerly worked with him in the laboratory but who had not seen him for over a year went up to him, Nick was at first indifferent, then he ran away, then crouched at his feet and turned on his back. When petted by H.S. he got

up and ran away a few yards and urinated once. However there was no erection. On the same day Nick fought vigorously with a male hound 2 years old—in marked contrast to his laboratory behavior of bluffing, running away and never fighting.

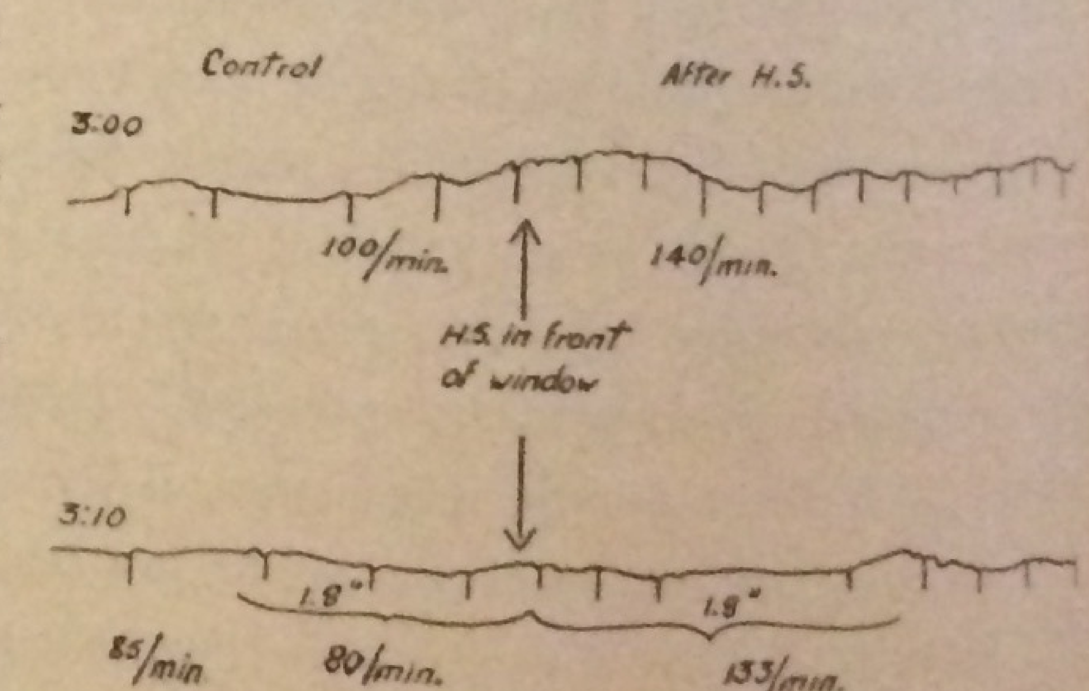
His heart rate varied from 115 when held by the farm attendant to 135 when held by me or by the laboratory assistant, H.S., whom I took to Virginia for observation of his effect on Nick. Nick had not seen H.S. for over a year. The cardiac acceleration to H.S. was now not so great as it was in the laboratory. 30 minutes later at 12:05 when Nick was standing near a female in estrus his heart rate went from 125 to 150, and with a cat clawing him and spitting at him the heart rate was 140-150. In contrast to his earlier and later behavior when under greater stress, Nick was friendly and quiet with me; there was no erection nor urinating in my presence; his heart rate was about 80. On the 13th he lay quietly by my side in the house without urinating for one hour; pulse 80-100.

The evidence for his improvement in the country was as unmistakable as was his changed relationship to me.

1941

He was shipped by express to Baltimore on 14 January, 1941, arriving at 10:45 the next day. Taken to the paddock by H.S., he pulled vigorously on the leash, running through the corridor, not attempting to enter the laboratory (he formerly had halted at the door, waiting to be taken in). He urinated at the door of the elevator, on the 6th floor corridor, and in the paddock 7 times within 5 minutes, panting heavily. He paid little attention to H.S., but jumped up on a new laboratory assistant (A.E.) twice. During the day he was quiet and very friendly toward me. Thus the contrast to his behavior on the farm was unequivocal.

On 16 January, 1941, his activity was still high but about one half of what it was when he was in the laboratory before. When allowed to run loose at 14:00 he started the noisy panting and jumped up on R.B., whom he had never seen, in preference to me and completely ignored H.S. At 17:00, demonstrated before a group of students, there was moderately raucous breathing, a pronounced erection (protrusion of the penis 2 cm.) for 90 seconds when he was first brought in, active running about and jumping on members of the group and on R.B. His heart rate and respiration taken at 14:30 showed hyperactivity to the presence of H.S., even when he passed in front of the window (see heart records, Fig. 14).



Effect of experimenter on heart rate (Nick) 16 January, 1941

FIG. 14.

When allowed to run in room 529[21] the raucous breathing appeared; he ran and jumped on A.E., then ran to H.S. but groveled at his feet, had a prominent erection lasting three minutes. He repeatedly (four times) ran to the feet of H.S., groveling and with erection, or else came near to H.S. when called but then crouched and turned away; on the contrary he jumped up on A.E. His behavior to A.E. and to H.S. is in striking contrast; to me it was intermediate, now

[21] 529 is a large upstairs laboratory room where Nick had never worked before.

groveling, now jumping up on me. Erection started while he was near H.S. and lasted while he was jumping on A.E.

Nick was quiet in the paddock most of the time after his return. When allowed to run in 529 at 9:30 raucous breathing began, he urinated but once in 529. He ran to A.E. and jumped on him, ignored H.S. completely though H.S. was standing by us and calling him.

When Nick ran into the new camera and slipped on the linoleum, he had a prominent erection immediately but it lasted only a few seconds—shorter than with the "anxiety" states. This was evidence that erection in Nick can be a reaction of fear as well as a component of the "anxiety" seen previously.

When allowed to run in 529 for 5 minutes (18:00-18:05), there was no erection but he urinated four times. He ran into the new camera when I went in, slipped down on the linoleum as he did formerly, had an erection with orgasm and ejaculation for 80 seconds, which quickly subsided when he went out of the camera. While in the camera Nick crouched at my feet after slipping down—another evidence that the erection is a component of fear. At 18:10 he followed me around, groveled at my feet having an erection at first, but after I petted him, the erection subsided and he no longer crouched and groveled but turned up on his back for me to pet him. When I told him to go away, he immediately had an erection for 10 seconds, with raucous breathing. He licked my hand, ran out eagerly with me when I got up to leave.

On 6 February, when running in 529, Nick was very playful with me, the same as he had been on the farm. This behavior is in contrast to the absence of playfulness before he was taken to the country.

On 7 February, Nick attempted copulation with a female who did not seem in estrus, after a few trials he finally inserted his penis for several minutes.

On 11 February, "while I am sitting in a room about 100 feet away from Nick's cage, he whines. Later when I release him he runs about the large room (529), sniffing where the female dog (D) who was in estrus had been, and urinating in certain places on the floor where he sniffs—apparently where she had left olfactory traces. After urinating he paws and scratches vigorously with all four legs, having a sexual erection as he had done in the country. The whole behavior is evidence of intense sexual excitation."

On 12 February, "Nick is whining in his cage when I approach. When released, he dashes out excitedly with the typical marked raucous panting. An erection appears as soon as he runs into my office, and also while he is running about in the large room between this and his cage."

On 20 February, "Nick has been much more restless in his paddock recently, with whining, barking, and jumping about in the cage. This is perhaps a result of a female in estrus (Omsk). He became very excited whenever she was brought near his paddock, though for the past three days she had not been close to him."

On 25 February, at 15:35, Nick was taken out of his paddock into the room where the female (Omsk) was tied. He immediately ran up to the female, began copulating without any preliminaries, and continued copulatory movements for 75 seconds after mounting the female. The duration of erection and union—from the beginning until withdrawal—was 23 minutes. To demonstrate in Nick the predominance of the sexual excitation over food

excitation he was offered dog biscuit (Kibble), which he ordinarily ate readily, at 15:50; these he refused although Omsk, the female with whom he was copulating ate them (compare this inhibition of the food excitation by sexual excitation with the inhibition of the defense movements by the sexual activity in Nick as seen previously).

Nick was returned to his cage until 18:02; on being released, he ran around sniffing where Omsk had urinated, several times over places where she stopped. At this time Nick was, however, comparatively quiet; he did not show the customary restless dashing about—perhaps a relief of tension after coitus.

On 27 February, Nick was taken into a new camera at 15:50 and his heart rate measured. This was somewhat elevated over what it had been on 16 January when he was first brought back from the country, 120 now compared to about 100 then. His respiration was extremely rapid—150 to 200 for 5 minutes.

At 16:10 Nick was taken down to room 120—the experimental environment of conflict—where he had not been since 25 August, 1939, when his heart rate was 205. The effect of the prolonged absence from this environment, possibly plus an influence of the dog in estrus on 25 February, was clearly evident in the much less agitated general behavior and the nearer normal heart rate. However, that the environment was still potent as a disturbing stimulus could be seen from the refusal of food, the slight retreating movements from the auditory stimuli in the camera, the inhibition of the food secretory crs, and the inhibitory effect on sexual reflexes in normal coitus. A detailed description of the experiment follows.

Nick ran around fairly actively but he was much quieter than before going to the farm in 1939. He did not dash in and out of the camera, nor violently jump on and off the stand as he used to do. He still preferred strangers, jumping up on the doctors and students present at this demonstration but never once approaching H.S. or W.H.G. He ate the ovals both in and outside of the camera and even on the stand. The fastening of the leash was sufficient to inhibit the eating. When the salivary disc and electrodes were attached he turned away from the food and gave practically no secretion even when the biscuits were held close to his nose—inhibition of a strong natural cr. With the food forcefully put into his mouth, however, there was a small secretion (UR), though there was none to the metronome or bubbling sounds; to these he backs off from the corner whence the tone used to come, but which location was changed 6 years ago. The reactions to the auditory stimuli were mainly passive defense—retreating—without any element of the normal investigatory reflex. However the whining, barking, and extreme violent movements formerly present were absent in this defense.

He was much quieter when someone (E.B.A.) was in the camera with him; a fact which had been demonstrated throughout his life.

About 16:40 the female in estrus with whom Nick copulated on the 25th was brought down. When this dog was tied on the floor in the camera about 3 feet from Nick his behavior to the disturbing auditory stimuli changed only slightly. Not until she jumped on the table and sniffed at Nick did he pay attention to her, and then his anxiety-like response to the metronome was almost abolished. When taken off the leash he mounted her and tried to copulate with her several times on the table but ineffectually; also inside the camera on the floor after several mountings, coitus was not completed. When taken outside the camera in

the experimental room he had to mount her and get down 5 times before effective union (as the erection was incomplete), in spite of the fact that the female appeared in a most receptive attitude, sniffing and rubbing up against him. On the 5th trial orgasm occurred 3 minutes after beginning of coitus and union lasted for 19 minutes compared with 23 minutes two days before. The environment of the antecamera (conflict) thus had a markedly delayed effect on the latent period of erection, less on its duration. The chief difference was not in the duration of the erection but in the long preliminaries. The single comparison would not be significant except for the many other similar observations previously made.

During this union and for some minutes after there was, as previously noted, a refractory period of some minutes when the metronome had no effect on Nick. For the first 15 minutes of coitus, the metronome had no disturbing effect on Nick (shown by the absence of usual defense reactions), but when the metronome was given again at 19 minutes Nick immediately withdrew and dismounted.

"After coitus Nick eats readily both in the antecamera and in the camera, and there is little or no defense to the metronome for several minutes after coitus. In marked contrast to his usual fumbling with food, he does not even drop it though the metronome is sounding. This non-reactivity to the metronome is another instance of the refractory period following sexual excitation."

On 16 January in room 529, Nick's heart rate averaged 99 between 14:31-14:48, continuous electrocardiograph. On 27 February (six weeks after his return to the laboratory) in the old experimental environment (room 120), the heart rate while Nick was standing quietly in the camera was 123; during the action of the metronome it went up to 134.

Summarizing the effect of the 17 month removal from the experimental environment of conflict, Nick showed less general hyperactivity in his running and jumping, no whining nor barking to the metronome; but he retained the reactions to stimuli of the past rather than those of the present, revealed in the inhibited salivary and food crs and retardation of the sexual reflexes.

On 28 February, 1941: Nick was quiet in his paddock. When brought out and allowed to run in room 529 there was a moderate sexual erection, moderate pollakiuria (6 times in 5 minutes); when placed on the stand in the camera he urinated on one of the supports even though he was on leash. This is the only instance that I have ever seen either here or in Pavlov's laboratory of a dog's urinating on the stand, although some of them are kept there 7 or 8 hours during prolonged experimentation. The urination may have been caused by the scent of the female in estrus, although other male dogs brought in on the same day did not urinate there. There was some panting and noisy breathing while Nick was running around.

On 22 March Nick was transferred from an inside to an outdoor cage. He ran quickly up the steps, but as soon as he entered the paddock (one which he had occupied before going to the country) he defecated and urinated immediately, having a marked erection, but lasting only a short time—about 3 seconds during the defecation.

During March 1941 a study of the effect of the experimental environment on sexual reflexes was carried out by measuring on alternate days sexual reflexes when Nick was inside the camera and when he was in the antecamera. Contrary to previous observations before he

had been taken to the country, there was no appreciable difference between the sexual reflexes in these two rooms. There was, as has been noted previously, a wide fluctuation in the duration of erection, from two minutes to twelve and one half minutes. See chart on sexual reflexes under discussion of special symptoms.

On 14 October, "Nick had been in his paddock in the medical school since January. When brought down today for demonstration, he exhibited the usual behavior—loud, raucous respiration, running to the feet of a stranger (D. J. Larson) in preference to W.H.G. or to H.S., dashing in and out of camera, jumping on and off the stand, refusing food. As soon as he was fastened on the stand there was immediately a slight erection, with protrusion of penis about 1 cm. lasting 3 minutes."

1942

On 13 January, "Nick brought down to 529 by H.S., at 16:30. Fairly quiet when tied, but when released runs about panting. Will not go to H.S. when called, though climbs up on student whom he has not seen before, on A.E., and on W.H.G. Goes into camera, sniffs floor (probably where female has been) and has sexual erection for 2 or 3 minutes. No dashing in and out of this camera. Begs for food by standing on hind legs and eats greedily from pan of biscuit moistened in cod liver oil."

"At 16:45 taken to room 120. Dashes in and out of camera, jumps on and off table with increased panting and agitation. Eats from same pan as he did in 529 both inside and outside camera. Continues eating during first 20 seconds of Bu, though afterwards hesitates. After third repetition of Bu, Nick will no longer accept the same food that he ate greedily in 529, but turns away from it; he gives slow labored respiration during Bu, and backs off from former position of tone. When released at 16:55 he eats in the camera again. In the antecamera he eats greedily, but stops, walks away and whines when A.E. whistles. This action is repeated to the whistling for three times at about 1 minute interval, during which he returns to the food. On fasting stomach, there is hyperacidity." (See next chapter.)

On 20 January, "In 529 Nick brought down for taking gastric juice with tube. Submits as usual without aggression. In the presence of two strangers (Drs. Rich and Whitehorn) runs and jumps up on them but by-passes H.S., will not go to him even when he calls Nick. When J.C.W. transfers Nick from himself to H.S., Nick immediately crawls down with tail tucked. Hyperacidity found in the fasting stomach."

On 19 March, in order to determine the therapeutic effect of replacing the conflict by training using the same csi but basing them upon another UR center (Pavlov's terminology) or drive (psychiatric terminology), Nick was brought down to room 529 for a new series of experiments. A tone (T256) similar to the one he had had as a cs for food in room 120 was made a cs for a faradic shock to the foreleg. 3 seconds after each tone Nick received a short faradic shock sufficiently strong to cause him to lift the foreleg and whine slightly. In such daily experiments between 19 March and 16 April Nick reached a level of 65%, i.e., on 25 March he gave a positive cr to 65% of the 20 repetitions of T256 used on that day; and by 15 April he had reached 100%. A differentiation was then introduced between T256 (+) and T512 (—). This routine continued to 20 June 1942. The differentiation was perfect only on one day during 1942 (14 May) after about 186 repetitions of the negative tone with the positive.

His behavior in these experiments was markedly different from that which had been seen

with him in the experimental room since 1932—before the neurosis. He was now generally quiet in the camera, there was very little restlessness or overactivity, no barking, no struggling, the breathing was much quieter, there was only slight panting not nearly so marked as in 120. In marked contrast to his behavior in the old camera, where sexual erections occurred nearly every day, there were no sexual erections with the new routine. He stood with tail slightly tucked, and whined to each faradic shock but very little in the intervals.

Although the pathological sexual erections were absent in the new environment, sexual reflexes to adequate stimulation were much more prolonged than in the old environment. Fluctuation from day to day, however, was still a prominent feature.

On 24 March, "In room 529 Nick runs around with slight panting, grovels at my feet, jumps on me, rolls on back, has erection lasting for 3-5 seconds, runs into camera while another dog is on the stand and jumps up by him, tucks his tail, stands quiet there, looks down at the floor. There is no whining, only occasional panting. In contrast to his behavior in 120, Nick has become much quieter working in 529."

On 16 April, "Nick up to this time had daily repetitions of only the positive cs (T256) to the faradic shock, and on 15 April he reached a level of 85-100% correct responses to the tone. On 17 April a differentiation was begun between T256 (+) and T512 (—). By 27 April he had a fair differentiation—80% to T256 and 0% to T512. Subsequently there was some loss in differentiation; during May although the inhibitory reactions to T512 were maintained, the percent of positive crs to T256 fluctuated around 50%, with marked daily variation. Nick was frequently fairly excited. His heart rate on 16 April, for example, gave a control reading of 110, a positive cr of 116 and a cardiac UR of 119. There was thus less tachycardia to the pain and to the new environment than there had been. The induced sexual reflexes showed a prolonged duration—around 10 minutes, compared to 3 or 4 minutes in 120. There was little or no evidence of spontaneous erections or pollakiuria during this period."

On 19 June, 1942, Nick was brought down to 120 for the first time since 13 January. As he approached 120 on the elevator, there was loud raucous breathing. In the antecamera he did not show so much hyperactivity as he did during 1941 and previously. There was less of the manic, obsessive dashing in and out of the C. But he urinated four times within the first 3 minutes, he refused the Spratts ovals in both antecamera and C, and there was an erection for a few seconds when he was shown this food; he picked them up and dropped them as heretofore. He continued to show preference for visitors and aversion to H.S.; he ran and jumped first on Mrs. C.W., whom he had never seen before, then on Dr. R.W., then to a new laboratory boy C.D. whom he had seen for the first time that day. He came to me only when I called him, and would not go to H.S. even though he called him repeatedly. Inside the C there was much less hyperactivity except for the panting, the auditory cs (M and Bu) in striking contrast to their former effect now were practically without influence upon his behavior when repeated 3 times.

There is thus indication that the procedure of using the auditory cs which formerly produced the anxiety in 120, as a new cs for a motor defense cr in 529 has extinguished the pathological anxiety reactions to the specific auditory signals but it has not abolished the effect of the total environment of 120.

In July, "14:30 Nick brought to 120. Two students (M. Tunick and Coppola) and a

new laboratory boy (C.F.) all of whom Nick had barely seen before, were present as well as H.S. and W.H.G. Nick first runs to M.T., jumps up with forefeet on her, then up on Coppola, then up on me. Does not go to H.S. even when called. Urinates three times first 5 minutes. Refuses food in both antecamera and in camera. Panting continues all the time he is in the laboratory. There is not as much hyperactivity, though he still runs in and out camera, jumps up and down on table. The salivary cr to food placed under his nose (2 cm. distant) was absent; there was slight salivary UR secretion when food was forced into the mouth. Coppola is impressed by improvement of Nick over last fall when he saw him. To auditory signals (Bu, M) Nick gives very little response. The procedure of retraining in 529 apparently has removed specific effect of auditory signal but not effect of whole environment."

On 10 October, "Nick is lying down quietly in his paddock. On being approached he starts barking, giving the normal reactions that the other dogs do. Soon he starts the laborious asthmatic-like breathing, which alternates with the rapid panting. When brought out he runs first to the feet of the visitor (B.S.) rather than to W.H.G. During the next 5 minutes carried through the halls, he urinated 11 times. When brought into 529 he shows no increase in symptoms. Taken down to 120 he urinates about 5 times in the next 5 minutes. His activity increases steadily during the time he is there. He also shows preference for B.S. over W.H.G., running to the former several times but not once to W.H.G. When told to go into the camera, he dashes in and out, jumps up and down from the table, looking down toward the place where the tone originally came from, pausing and then panting and running out. He runs excitedly around the room as formerly. There is no sexual erection while he is in the room. Nick thus shows the same pattern of disturbed behavior in the dyspnea, the pollakiuria and the running activity. The individual auditory stimuli were not tried. His behavior in this environment is only slightly improved from what it had been, and seems somewhat worse than it was during the April, May and June when Nick was being actually worked on with the defense crs. He has not been experimented upon for 4 months, having remained in his paddock during this time. He is well nourished and in good physical condition."

On 27 October, a male dog Bamech was seen for the first time in his laboratory life to appear restless in the camera, not to take the food and to show reversal of the size of the crs (paradoxical phase). Although Bamech was a stable placid police dog, his behavior on this day was so similar to Nick's that it warrants description. He was restless on the stand, twisted and turned on the table, urinated about every minute in the antecamera, showed the same pattern of scratching with all fours after defecating that Nick had, tugged on the leash to get back to the paddock, where there was a female in estrus whom Bamech followed constantly around. Bamech, the female and Nick were brought down together to room 120. Nick made advances toward the female and attempted to mount her, and she would bite playfully at him. The behavior of Bamech and Nick in the antecamera with the female was very similar—pollakiuria about every 30 seconds (unabated by the disapproval of the experimenter). Nick also defecated on the floor with a marked erection showing the same pattern of scratching and spinning as previously noted. Neither Nick nor Bamech would take the food when sexually excited, although the female would—a difference in male and female noted previously.

The similarity of the behavior of Bamech under sexual stimulation to that of Nick in the environment of conflict is so striking that it will be discussed separately in the next chapter.

1943

On 12 January, "Nick brought to 120 for demonstration. Runs and jumps several times upon Professor Vivado and M.F. neither of whom he had seen before, once on W.H.G. but not a single time on H.S. Urinates several times in the antecamera. When first brought into camera he accepts food, even during the auditory csi, but not after he has been leashed to the stand. Nick gives almost no defensive movements to the auditory csi. In general he is much quieter, though there is still the raucous breathing. His improvement may be due to the therapeutic procedure of using the csi in another connection (*v. supra*) or advancing age" (fig. 52).

On 26 February, "Nick has not been used in routine experiments since 19 June 1942 when his differentiation between T256 (+) and T512 (—) was about 70% to the positive and 0% to the negative tones respectively (the tones having csi for a faradic shock to the foot). Tested after this 8 month interval the retention of the motor crs was practically perfect, viz., 90% responses to the positive tone and 0% to the negative. As a matter of fact his performance was even better after this interval; for in a few days he reached the level of 100% and 0% and maintained this differentiation regularly. The cardiac crs were not measured after the interval until 9 March, 1943, when they showed a differentiation of 164 heart rate with the positive cs and 151 with the negative cs, i.e., the positive cardiac cr was 115% more than its control and the negative cardiac cr was 109% more than its control, the motor crs being on the same day 100% and 0% to positive and negative csi respectively."

The explanation of the improvement in Nick's performance in the spring of 1943 even without intervening practice may be considered due to one of several causes: 1) he may have "learned" during the interim, a phenomenon described by William James (*60*) and given a factual basis in the experiments of Light and Gantt (*73*) who showed by paralyzing a leg (through crushing of the anterior nerve roots) that practice is not necessary for formation of crs; or 2) his improved record may be a result of his general improvement; 3) possibly the social factor may play a role since in 1943 Dr. Freile worked with him instead of H.S. or W.H.G., and with Dr. Freile with whom he had no previous associations he had already shown more friendliness than to H.S. or W.H.G. This factor is to be investigated.

On 16 and 17 March 1 cc. adrenalin 1:1000 was injected intramuscularly, and several times in April 1 cc. intravenously in both Nick and stable dogs to determine its effect on the crs. This is an enormous dose for a normal dog and even proved fatal to two healthy dogs. In Nick there was only a slight impairment of both the motor and the cardiac crs, viz., a reduction in the positive motor responses from 100% (control) to 80% (adrenalin) with the intravenous dose. The respiratory and cardiac rates were only slightly changed. In the more stable dogs there were violent alterations in respiration, cardiac rate, and in the motor crs. In Connie, e.g., the respiration was increased to about 300, the cardiac rate doubled and the positive crs reduced from 100% (control) to 50% (adrenalin). The differentiation between the positive and negative cardiac crs was also destroyed. The intramuscular injections had no effect on Nick but in Connie the differentiation was impaired also by this

method. Following the adrenalin, Connie often showed impairment. These results are indicated in figs. 19a and 19b.[22]

On 12 August, When Nick was taken from his paddock to be expressed to the farm in Virginia, he jumped obediently into the open cage and lay quietly. On arrival the next day he was much more friendly to me than he had been the previous times he was brought down. During the 6 weeks in the country he was usually quiet—less active than in 1940 and fairly friendly. He loyally followed me around on the farm almost everywhere. He would run after the car, however, at a speed less than formerly—12 miles per hour was his best running compared to 15 miles per hour on his previous visits. Nick began to show signs of senescence; he was apparently partially deaf, spent much time sleeping, snoring loudly, and was not easily aroused, although occasionally he seemed rather restless, continually running around.

Some of his old symptoms manifested themselves but not to a marked degree. Urination was more frequent than in most dogs but rarely occurred in the house although he had not been housebroken in the laboratory. No abnormal sexual symptoms appeared nor was there evidence of interest in females. He occasionally fought with other dogs instead of bluffing as previously. Nick's abnormalities were noted by several people who had not seen him previously. For example, two boys aged 7 said, apropos of his raucous breathing, "Gee that dog certainly does breathe funny." On another occasion when Nick suddenly ran from the sound of a wood chopper, the laborer remarked, "That dog must be gun shy."

Though Nick showed no evidence of being cooperative and as friendly with his master or anyone as other dogs, nevertheless he still appeared to learn rapidly. For example, although he would not come into the automobile when called to do so, he would immediately rush to the car whenever anyone got in or blew the horn in preparation to leave.

In connection with Dunbar's observations concerning the proneness of certain types for accidents, it is interesting that Nick showed this tendency during 1943 as well as previously. In 1937 he frequently got tangled in his chain, binding and hurting himself. In 1943 on the farm, he twice fell into an abandoned privy where he could not extricate himself and where he remained for some hours until he was located by his barking. He would frequently knock into things, get under people's feet, run into machinery, etc. On one occasion at night he followed my car without my knowledge, but as he could not overtake me, I met him on my return homeward. After passing him going in the opposite direction I turned around and went back, but he again had recognized my car and was again running toward me. I put on the brakes, but he continued running into the car which knocked him down and dragged him along, resulting in two scalp wounds. However, he trotted on home at a rapid pace, so that I did not find him until I had also arrived.

Nick came to an end in January 1944 perhaps appropriate to his life—he was killed accidentally in a fight with another dog. An autopsy showed slight bleeding points on the gastric mucosa but without definite ulceration. Gross examination of the organs by Dr. Rich indicated they were normal. Detailed studies have yet to be made.

[22] A further analysis of these experiments will be given in a subsequent paper (Freile and Gantt) dealing with the effect of adrenalin on behavior. Sufficient experiments have been performed at present, however, to indicate that our results are statistically reliable.

VI. SUMMARY OF OBJECTIVE SIGNS ACCORDING TO PHYSIOLOGICAL SYSTEMS

THE FOLLOWING epitome and classification of symptoms is intended to give a systematized picture of the behavior, rather than to isolate the symptoms as independent reactions. That each plays a role in the integrated response and the fact there are reciprocal relations is evident from the previous account.

The abnormal appearance of the symptoms consisted in 1) either too much or too little response in the given situation, i.e., too much excitation or inhibition; or 2) appearance of entirely new reactions. The marked character, regular manifestation, and stereotypy of pattern of many of the symptom-complexes if they had occurred in the human patient, would probably have led to diagnoses of cardiac, respiratory, urinary, sexual, etc., neuroses.[1]

But as it is the purpose of these experiments to trace the forces at work in producing and maintaining the nervous disturbance rather than to make a diagnosis, clinical correlations will be kept subservient to a presentation of the objective manifestations and their relationships.

1. ACTIVITY;[2] METABOLISM — see summary p. 108

Marked changes in activity have been reported during the presence of various animals in the environment of conflict, ranging from rigidity and catalepsy to greatly exaggerated manic-like behavior (Pavlov, Liddell, Maier, Masserman, Dworkin). In our series of disturbed dogs during the situation of conflict, one of them would fall into a deep slumber with complete relaxation lasting 15-30 minutes (*76*). Such sleep is different from the brief sleep often accompanying normal inhibition. Pavlov has reported many such instances; H. G. Wolff (*110*) and I had a dog (Kompa) who regularly fell asleep on the 7th to 9th second after the beginning of the inhibitory metronome. Nick however showed almost maniacally exaggerated activity whenever he was brought into the experimental camera—dashing in and out of the camera, jumping upon the table and running about the room. His activity was in marked contrast to that of normally hyperactive dogs such as Billy, who would playfully run to all parts of the room, while Nick's

[1] By the use of this term I do not intend to do more than make a superficial analogy to what is often referred to under the ill defined term *neurosis*. Since it is impossible in the dog to use any system involving subjective feelings—often the main criterion in the human—it is important to have a clear picture of the objective manifestations ("signs").

[2] The method of recording 24 hour activity has been adapted by Muncie and Gantt from that used by Curt Richter (*94*) in the activity of rats; it records movement in a horizontal but not in a vertical direction.

running was mostly in and out of the camera in a stereotyped manner. As the camera represented conflict for Nick, this may be likened to the compulsive behavior of patients. Nick's running was usually accompanied by rapid raucous breathing, giving the impression of an animal being pursued.

Not only in the camera but in his 24 hour activity, measured in the paddock, Nick showed exaggerated activity—much greater than that of any other dog—with wide fluctuations from day to day. As previously stated Nick's running was not equally affected by the same factors that determined the running of the normal dogs, i.e., there was a low correlation coefficient between Nick and the normal animals. Nick's activity has been approximately the same in pattern during the whole time that it has been recorded, from 1934 to 1941, with several periods of diminished activity, parallel to his improved behavior. Outside of the laboratory on the farm, though he was active, most of the symptoms of abnormal-like activity were absent; also the 24 hour activity was reduced and more nearly normal after sexual activity. The increase of the activity seemed to parallel the abnormal behavior in the camera.

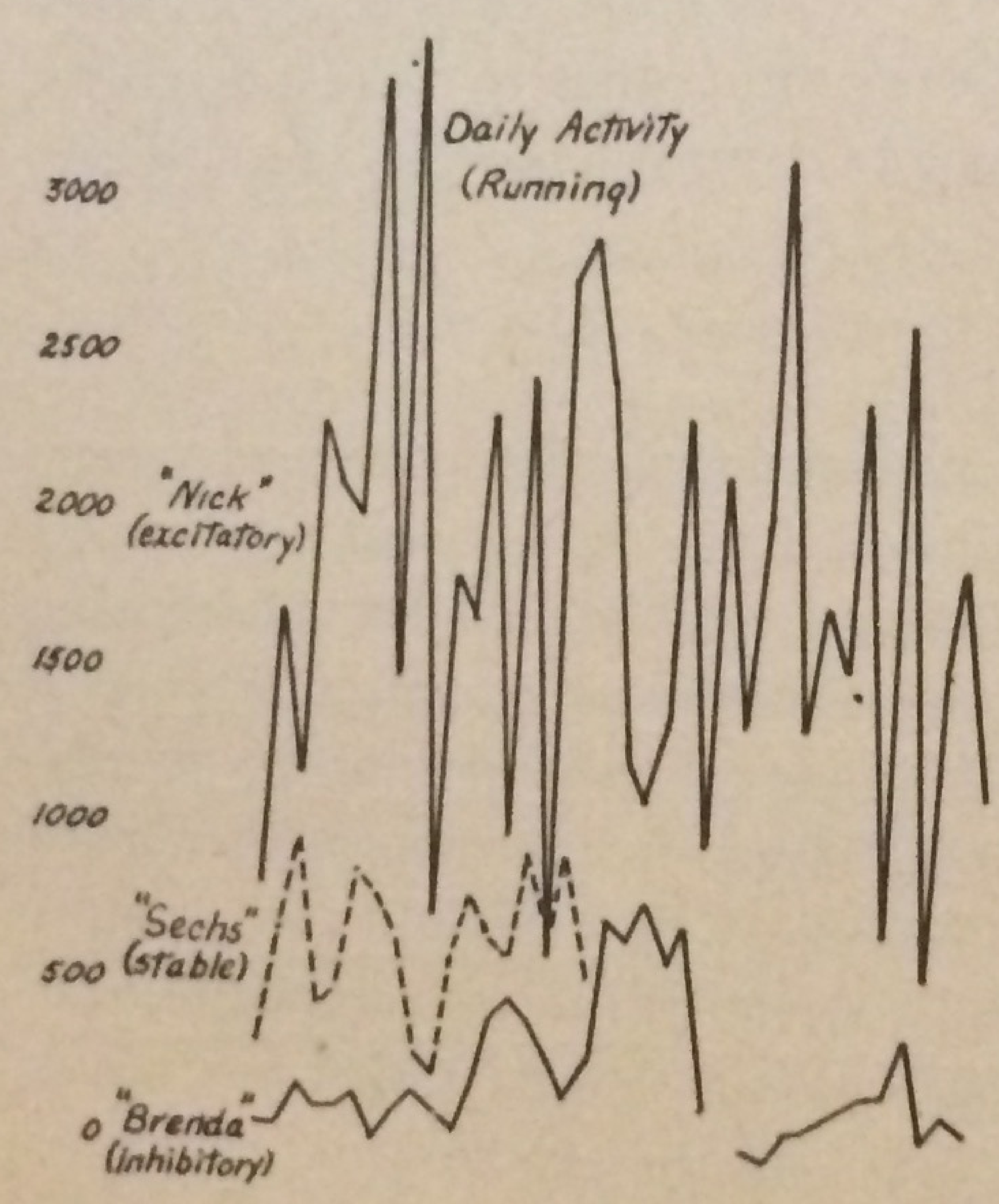


FIG. 15. Samples of activity from Nick (excitatory) Sechs (stable) and Brenda (inhibitory).

Below are samples of the 24 hour activity from Nick, in comparison with two normal dogs—one an extreme quiet, stable phlegmatic type (Sechs) and the other a pathologic inhibitory type (Brenda) (fig. 15). Although quantitative activity records were not made on Nick prior to 1934 and no comparison of his 24 hour activity is possible before and after the development of the neurosis, it was evident that the behavior in the camera showed greatly augmented activity after the conflict.

An interesting aspect of the 24 hour activity is the correlation coefficient among the normal dogs, as contrasted with the correlation between Nick and the normal dogs. Three of the activity cages (nos. 1, 2, 3) are alongside each other and in the open air so that the dogs can see and hear one another though they are separated by gratings. Cage 4 however is an inside one and completely separated from the other three. A correlation was made between Nick and a normal dog when Nick was in the cage alongside the other dogs and also when he was in cage 4 separated from the normal dogs. Positive correlations were found among all the normal dogs, i.e., when the ac-

tivity of one normal dog increases[3] the activity of the other normal dogs also increases; the fluctuations move in the same direction, but the activity of Nick (as well as of another neurotic dog, Brenda) is independent of the others (44).

Table 18 and fig. 16 show these relationships. Vera, Billy, Ephraim, and Pat always showed normal behavior with the exception that Pat on one occasion appeared to suffer a slight disturbance of behavior.

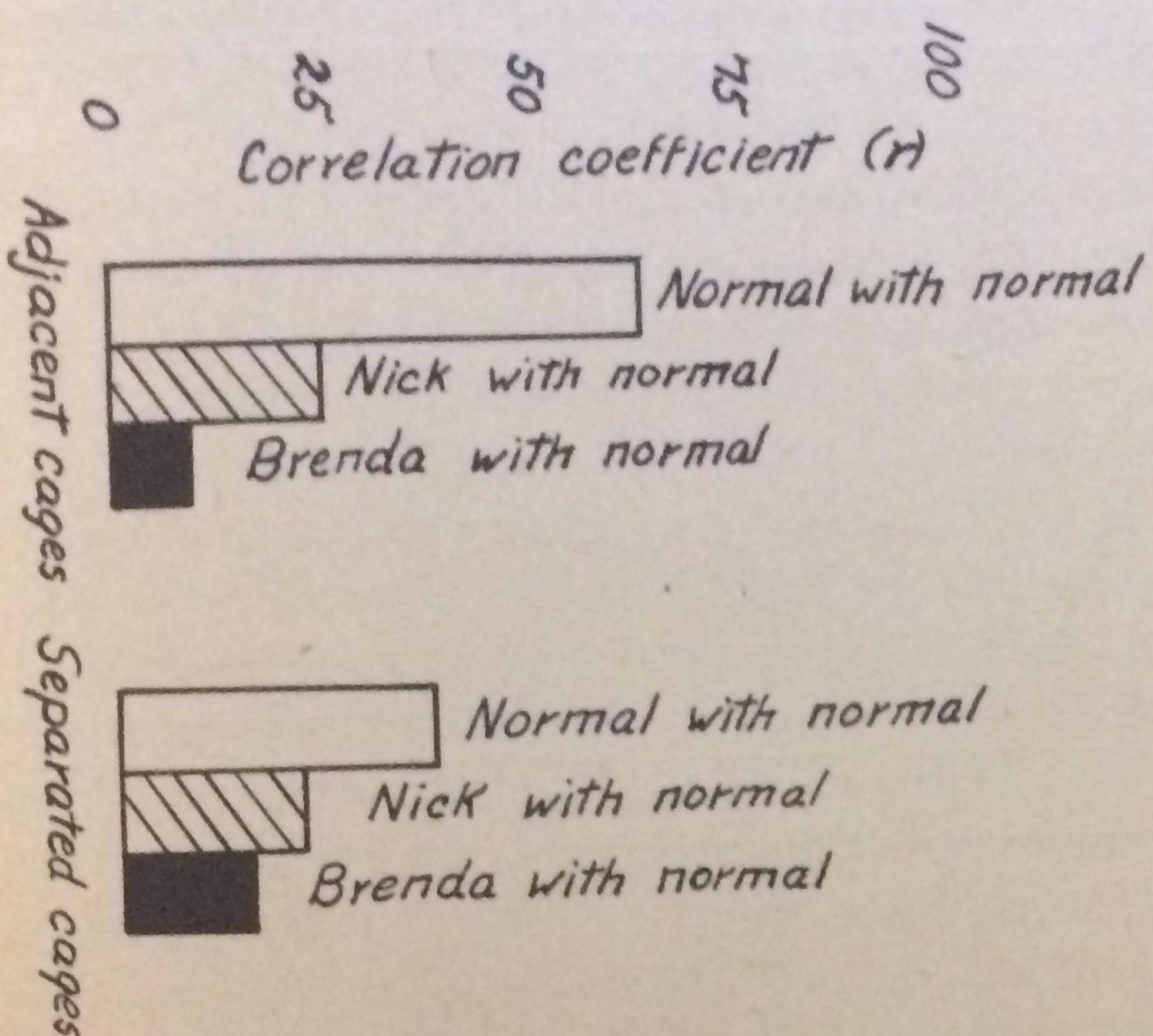


FIG. 16. Activity correlation among stable dogs and correlation of labile dogs (Nick and Brenda) with stable dogs.

From Table 18 it can be seen that there is a definite positive correlation among all the normal dogs when they are in adjacent outdoor cages, but that there is no correlation between Nick and three normal dogs nor between Brenda and two normal dogs regardless of whether they are in adjacent or separated cages. A reference to statistical Table 20 indicates that in most of the cases except Nick's there is less than one out of 100 or more chances that the high correlation coefficients could be due to random fluctuations. The fact that Nick's activity, i.e., the distance that he runs daily, is independent of that of his neighbors, even though he is in the same environment with them is in accordance with his aloofness from other dogs and his marked lack of rapport. This was observed on many occasions, e.g., in his early life (1932) when Nick in contrast to Fritz and other dogs together in the paddock was seen to shun a female in estrus when he was with a group of other dogs.

[3] Whether this increase and fluctuation is mainly due to humidity, temperature or other meterological changes, as suggested by Peterson, cannot at present be answered (92).

The coefficient of variability (v) for the daily fluctuations was: Polkan—40, Sechs—44, Fritz—44, Ephraim—50, Billy—50, Nick—48, Brenda—50. This

TABLE 18

CORRELATION COEFFICIENTS FOR ACTIVITY

Name	Adjacent Outdoor Cages			Separated (Outdoor-Indoor) Cages		
	r	N (no. cases)	P	r	N	P
Normal dogs						
Billy-Polkan	0.21 (Nov. '35–Feb. '36)	65	.05			
Sechs*-Ephraim	0.28 (Jan. '38–Apr. '38)	62	.02	0.32 (Apr. '38–June '38)	78	.01
Ephraim-Pat	0.38 (May '37)	31	.02			
Fritz-Ephraim	0.50 (May '37)	50	.01			
Billy-Ephraim	0.55 (Dec. '37–June '38)	141	.01			
Vera*-Pat	0.56 (Nov. '35–Feb. '36)	30	.01	−0.12 (Oct. '36)	13	.1
Fritz-Billy	0.57 (May '37)	51	.01			
Sechs*-Billy	0.72 (Jan. '38–Apr. '38)	60	.01	0.55 (Apr. '38–July '38)	89	.01
Normal-Neurotic dogs						
Nick*-Polkan	0.43 (Dec. '36–Apr. '37)	91	.01	0.56 (Nov. '35–Dec. '36)	39	.01
Nick-Pat	0.13 (May '37)	31	.1			
Nick-Fritz	0.19 (Dec. '37–Jan. '38)	42	.1			
Nick*-Billy	0.00 (Apr.–July '38)	59	.1	0.00 (Dec. '37–Apr. '38)	104	.1
Nick*-Ephraim	0.02 (Apr.–June '38)	49	.1	0.08 (Jan. '38–Apr. '38)	66	.1
Nick*-Sechs				0.50 (Dec. '37–Apr. '38)	56	.01
Nick-Sechs*				0.28 (Apr.–July '38)	66	.02
Brenda*-Sechs				0.14 (28 June '40–10 Nov. '40)	39	.1
Brenda-Connie	0.09 (11 Nov. '40–5 Jan. '41)	27	.1			

Normal dogs (r)

Median of normal dogs: in adjacent outdoor cages (8 pairs) = .53
in separated outdoor cages (3 pairs) = .33

Neurotic dogs (r)

Median of Nick with normal dogs: in adjacent cages (5 pairs) = .19
in separated cages (5 pairs) = .18
Median of Brenda with normal dogs: in adjacent cages (1 pair) = .09
in separated cages (1 pair) = .14

* Indicates which dog of the pair is in indoor cage when separated.

A correlation coefficient (r) of 1.0 indicates complete agreement, while when r approaches zero the activity of one dog is entirely independent of the activity of the others. The nearer r approaches 1.0 the more nearly the fluctuations of the activity in the two dogs for whom the r is measured, are apparently influenced by the same factors. In the table where P is .1, it means a definite correlation cannot be established between the two dogs.

note

rather uniform variability is contradictory to the observations on the variability of most other characteristics of the neurotic.

Although insufficient day and night readings have been made on our neurotic dogs to settle the question of nocturnal restlessness, it is possible that the lack of correlation in Nick may have been a result of increased nocturnal activity, as pointed out by Liddell in neurotic sheep. This was observed on many occasions, e.g., in his early life (1932) when Nick, in contrast to Fritz and other dogs together in the paddock, was seen to shun a female in estrus when he was with a group of other dogs.

A striking parallel between behavior and the 24 hour activity record was seen in a year old female dog, Brenda, who had been raised in the country as a pet, brought to the city in the autumn of 1939. On 28 June, 1940 Brenda was transferred to the laboratory and for the first two weeks she barely moved from one spot in her cage except to walk a few feet to the food bucket. After being in the laboratory for 3 weeks her activity increased only slightly. On 24 July, 1940 she was taken to the farm where she remained until October 29, when she was returned to the laboratory. The activity record was parallel to that seen in the summer: for the first 2 weeks she lay motionless continually in one place. After 3 weeks the activity gradually increased again. The general behavior of this dog was parallel to the activity record. When she was brought out of her cage into the room she stood absolutely motionless in one spot with tail tucked between her legs, head down and back arched, and no matter how much she was coaxed, called, or offered food, she would not budge. The dog's behavior was no more friendly to me, her master, than it was to the others in the laboratory. The dog was taught with difficulty to eat from the food box. On those days when her activity was greatest she appeared more friendly and ate more readily.

With another dog, Blue, as a result of a natural emotional shock in 1932 it was noted that his posture was the same as Brenda's and that his observed activity was much subdued, (at that time the 24 hour activity was not recorded). Both Brenda and Blue were hypoactive animals and under stress the activity was still further diminished. Nick, a hyperactive dog, showed, on the other hand, decreased activity when his behavior was more nearly normal, e.g., after sexual activity. The change in activity under stress therefore varies with the type of dog.

The activity of the normal animal has been shown (*44*) to bear some correlation with both cr and UR activity. However notwithstanding the large amount of work that has been done on the subject and such highly interesting and suggestive observations as those of Peterson (*92*), the whole question of the meaning of activity is undoubtedly a most complex one, dependent upon many factors as shown by the extensive experiments of Richter on rats.

Summarizing the observations on 24 hour activity, a conflict may either increase

or decrease the activity depending upon the type of dog. Other factors, as the daily variability in the activity, were only slightly different for the normal and the abnormal dogs. The absolute extent of the activity is unimportant, but a change is significant and also the lack of correlation (rapport?) of the abnormal with normal dogs.

Blood sugar tolerance tests were performed on Fritz, Peter and Nick in 1932 and 1933, on the initiative of Oskar Diethelm. Diethelm (*15*), E. M. Bridge (*7*) and others have reported a correlation in patients between emotional states and the shape of the curve representing per cent of sugar in the blood after administration of a given weight of glucose on a fasting stomach. The tests were made during the period of increasing differentiation in the experiments on all three dogs. 100 grams of glucose were given orally in solution, allowing the animal to drink it in the morning on a fasting stomach immediately before the experiment, and blood samples were taken before administration and ½ hr., 1 hr., 2 hrs., and 3 hrs. thereafter. The test was repeated 9 times on Fritz, 16 on Peter and 20 on Nick (Table 19).

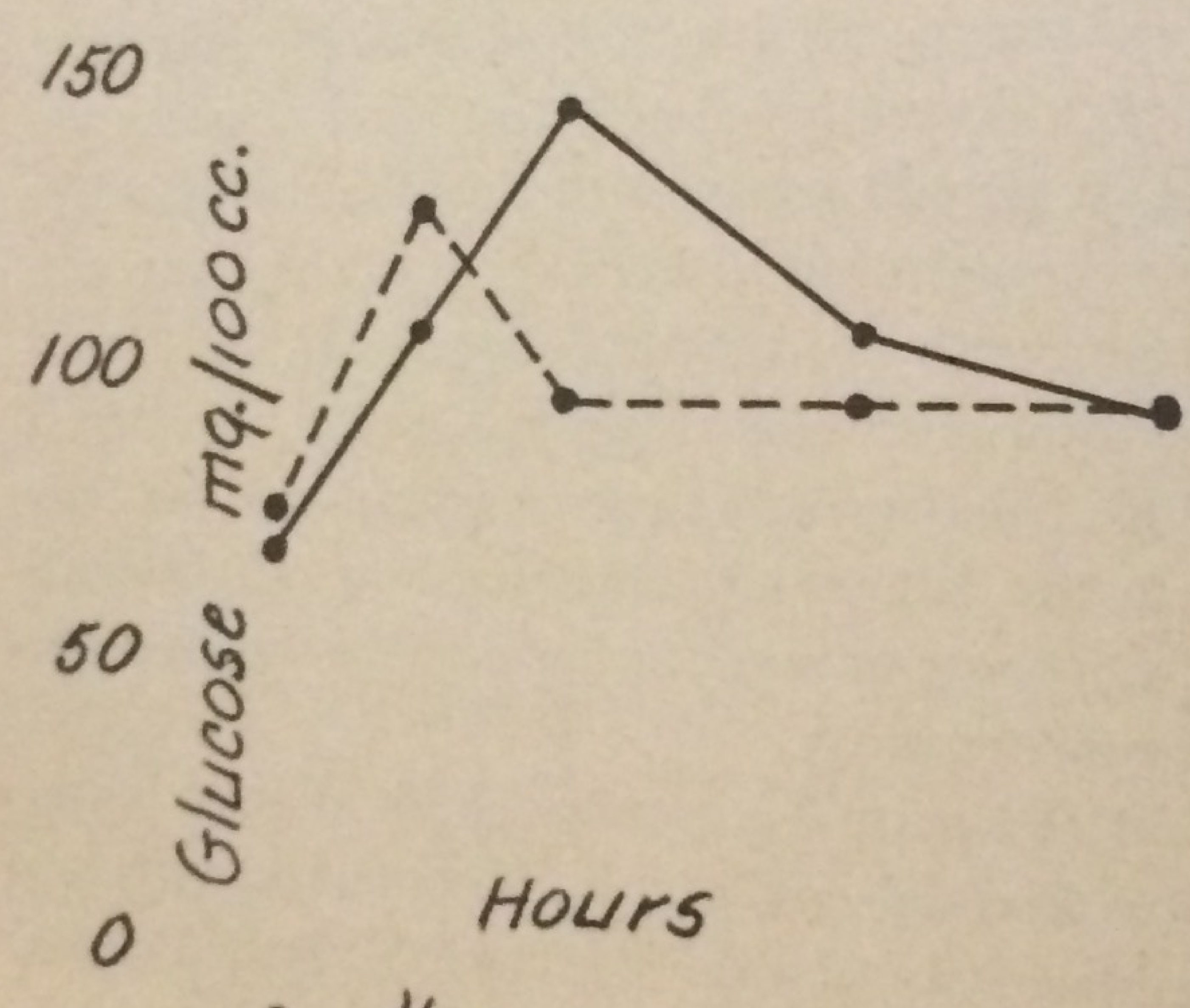


FIG. 17a. Blood sugar tolerance in Nick outside environment of conflict (dotted line); in environment of conflict (solid line).

Although it is not possible to see a correlation in the type of curve and the daily laboratory disturbance in the animal, two conclusions may be drawn, first, there is a difference in the blood sugar tolerance curve for Nick when he is outside the environment of conflict (in his paddock) and when he is in the experimental room. This is shown in fig. 17a. The curve for the blood sugar tolerance with Nick in his paddock is the average of two experiments; that with Nick in the camera, average of twenty experiments. This comparison indicates, according to the work of Diethelm (*15*) that the dextrose tolerance for Nick in the environment of conflict is more nearly like that seen in emotional states of patients, particularly those of tension and anxiety. Secondly, the pattern plotted from the average figures of all the experiments is correlated with the extent of the disturbance in each animal (fig. 17b). The pattern of Nick has the greatest rise; it is more nearly similar to the curves seen in states of anxiety while the curves for Fritz and Peter are

TABLE 19
BLOOD SUGAR TOLERANCE

	Fritz (9 Test Days)			Peter (15 Test Days)			Nick (20 Test Days)		
Hr.	Blood sugar (Mean)	σ	V	Blood sugar (Mean)	σ	V	Blood sugar (Mean)	σ	V
0	78 mg.	5.8	7.4	88 mg.	11.3	12.8	84.6 mg.	5.3	6.3
½	111	4.7	4.2	114	10.3	11.2	120	18.0	14.0
1	111	8.6	7.7	104	12.8	12.3	136	28.9	21.2
2	93	10.4	11.2	95	9.9	10.4	112	23.4	21.0
3	85	9.6	10.3	91	8.6	9.5	96	15.5	16.2
Mean:	93	8.6	7.7	95	10.3	11.2	112	18.0	16.2

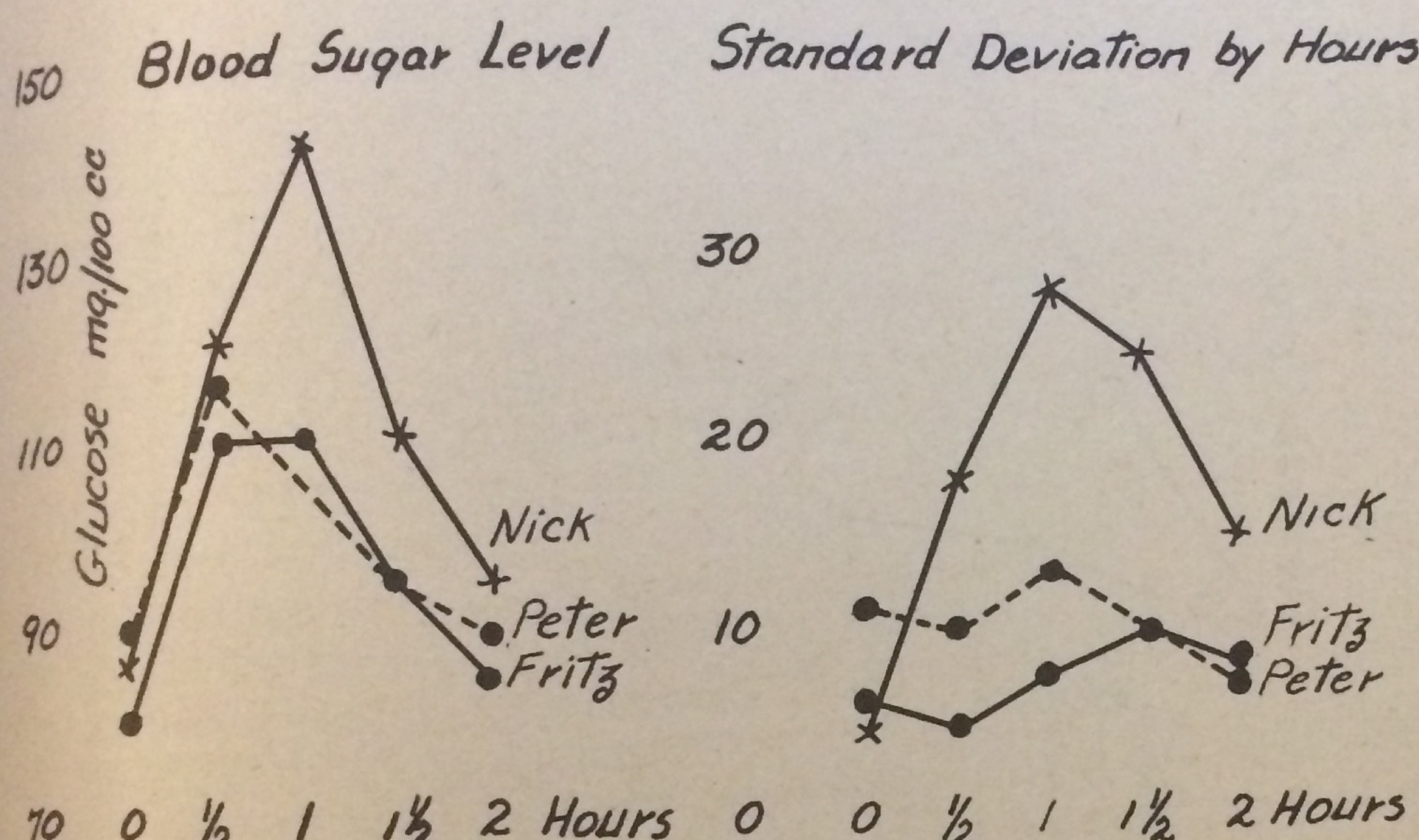


FIG. 17b. Blood sugar tolerance.

nearly identical. Comparing the means for each hour in the three dogs it appears that the curve for Nick is definitely of a different type than those for Peter and Fritz; comparing the hourly means of one dog with the other by Fisher's method, the P values[4] are as follows (Table 20). The table shows a significant difference

TABLE 20
P VALUES

	0 Hour	½ Hour	1 Hour	2 Hour	3 Hour
Nick and Fritz	.01	between .1 & .05	.01	.01	
Nick and Peter	.4	.01	.01	.01	.2+
Fritz and Peter	.01	.3	between .2 & .1	.6	

[4] P = probability, indicating where P is less than .05 that there is a real and not a chance difference between the two dogs. For calculation of P see Fisher (27 p. 114).

between the curves for Nick and the other two dogs except for the last hour; and no significant difference between Fritz and Peter.

Diethelm says of the curves, "Nick was the only dog whose blood sugar tolerance picture corresponds to patients who develop mounting tension, anxiety, fear" (personal letter).

The blood sugar tolerance is a measure of rate of absorption as well as of utilization of sugar by the organism. It is thus partly dependent upon intestinal motility and other gastrointestinal factors.

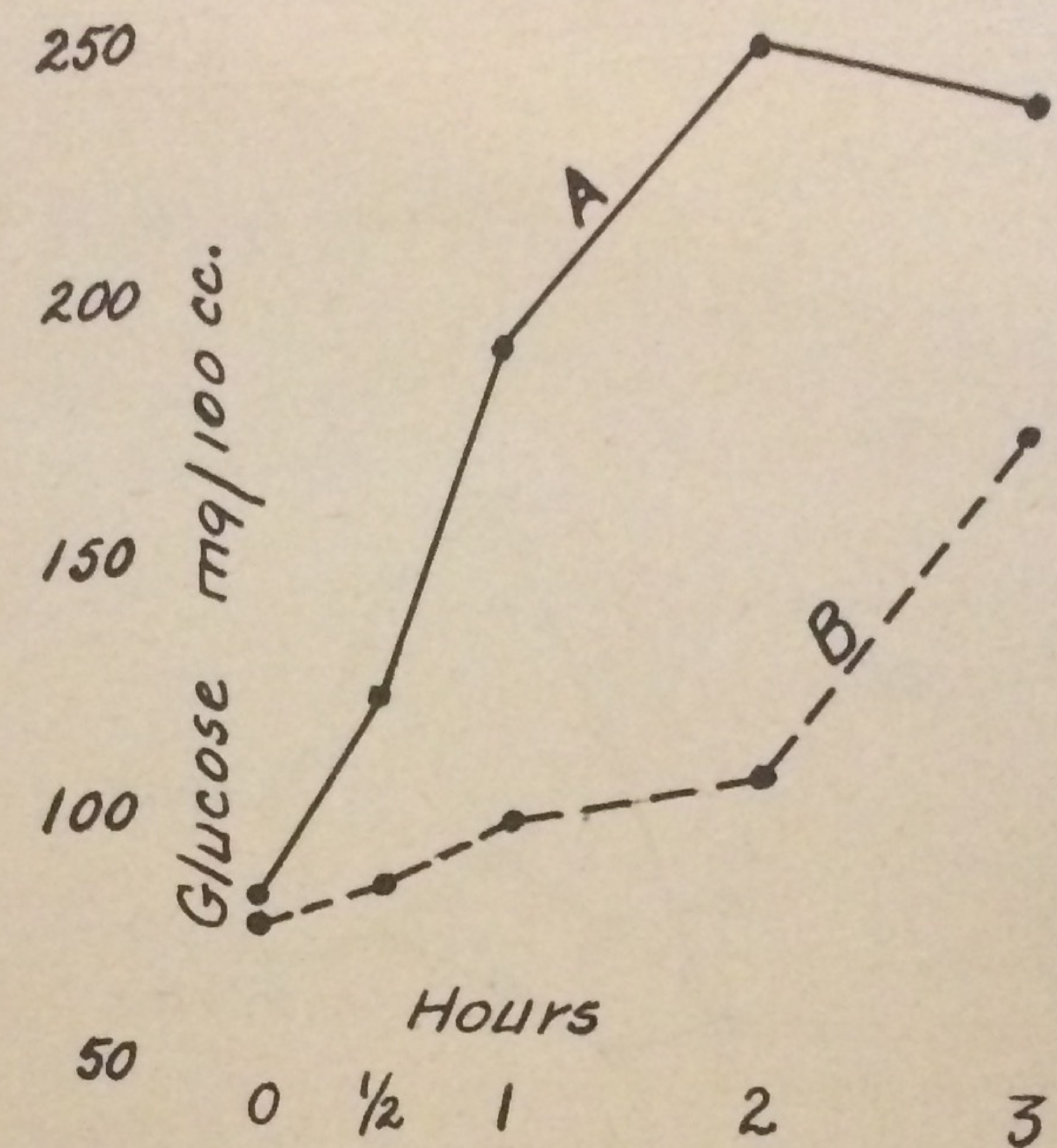


FIG. 18. Comparison of curves (A) after injection of adrenalin plus 100 gms. glucose and (B) after injection of adrenalin alone.

Fig. 18 gives a comparison of the curves for blood sugar A) after subcutaneous injection of adrenalin (1 cc.) with 100 grams of glucose given orally and B) after injection of adrenalin (1 cc.) alone. It is seen that the latter curve is approximately the summation of the curves produced by the adrenalin and the curve produced by 100 grams of glucose fed alone. Dworkin (91) obtained the same results in cats. Figs. 17a and 17b indicate that Nick has more sugar to handle (perhaps by liberation through the action of adrenalin) but "that he handles it just as well as do the other two dogs" (C. M. Brooks).

Remarkable and interesting data were obtained in Nick and other dogs during a study undertaken in 1932 (with Diethelm) and continued in 1943 (with M. Freile) on the effect of adrenalin on the crs. Table 21 shows in another dog (Kompa) a striking resemblance between the effect on the crs of fright and of adrenalin injection. Besides the conclusion that adrenalin as well as emotional disturbances impair differentiation, these facts together suggest but by no means prove that the secretion of adrenalin may play a role in the anxiety state of Nick. Further experiments strengthened this view. In 1943 Freile and I showed that the intravenous injection of adrenalin (.5 cc. to 1 cc. 1:1000) produced in stable dogs not only great increases in both the cardiac and respiratory rates (respiration as much as 300 per minute, with doubling of the heart rate) but a marked im-

note

pairment of the cr balance, while in Nick even the largest dose (1 cc., sufficient to be fatal in some dogs) exerted only a slight disturbance on respiration, cardiac rate and on the crs. In both dogs the impairment became worse with subsequent injections, and lasted for many days after five injections. In view of the fact that adrenalin is destroyed by the tissue within a few minutes, the central nervous system may undergo severe damage. (See figs. 19a, 19b).

TABLE 21

ACTION OF ADRENALIN COMPARED WITH FIGHT ON DIFFERENTIATION

	+CR	−CR	No. Observations
Control	115	0	16
Injection Adrenalin (1 cc.)	150	70	12
Fight (moderate, 5 min.)	165	60	4
Fight (severe, 24 hours)	0	0	8

Where tissues are denervated and therefore deprived of adrenalin-like substances they become more sensitive to adrenalin (Cannon and Rosenblueth [11]). Also where acetylcholin occurs in abundance, as around the heart, denervation causes the disappearance of the neutralizing cholinesterase as shown by Dale and his students. Hence if the sensitivity can be changed in one direction perhaps it can be changed in the opposite direction of decreased sensitivity. From these facts and the observations on Nick it may be hypothecated that the daily adrenalin secretion of Nick is of such magnitude as to render him immune to doses that produce a profound disturbance and even death in other dogs (Freile). The fact that we previously found a tolerance in dogs to the effect of repeated adrenalin injections on hyperglycemia also supports this view (36).

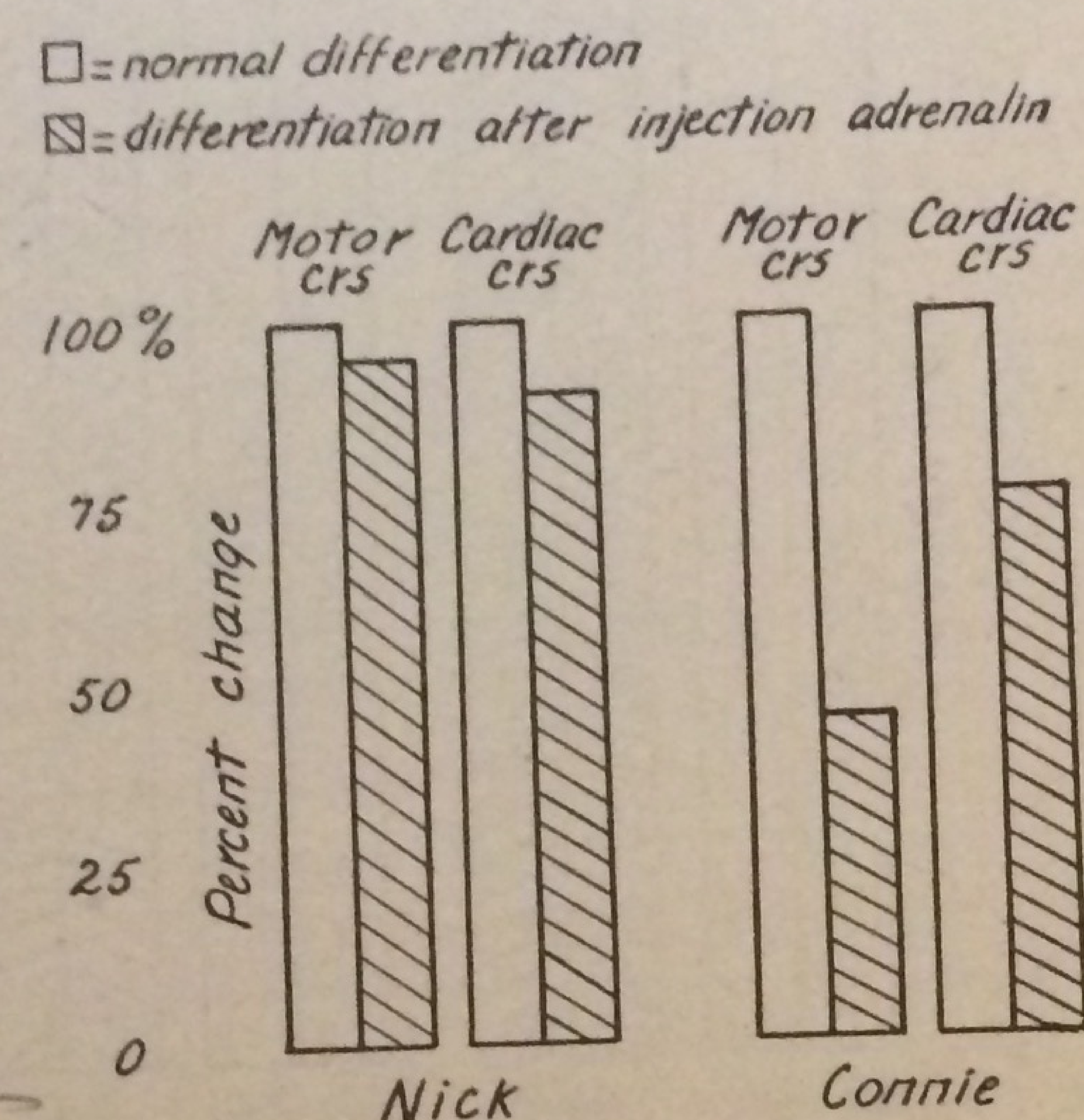
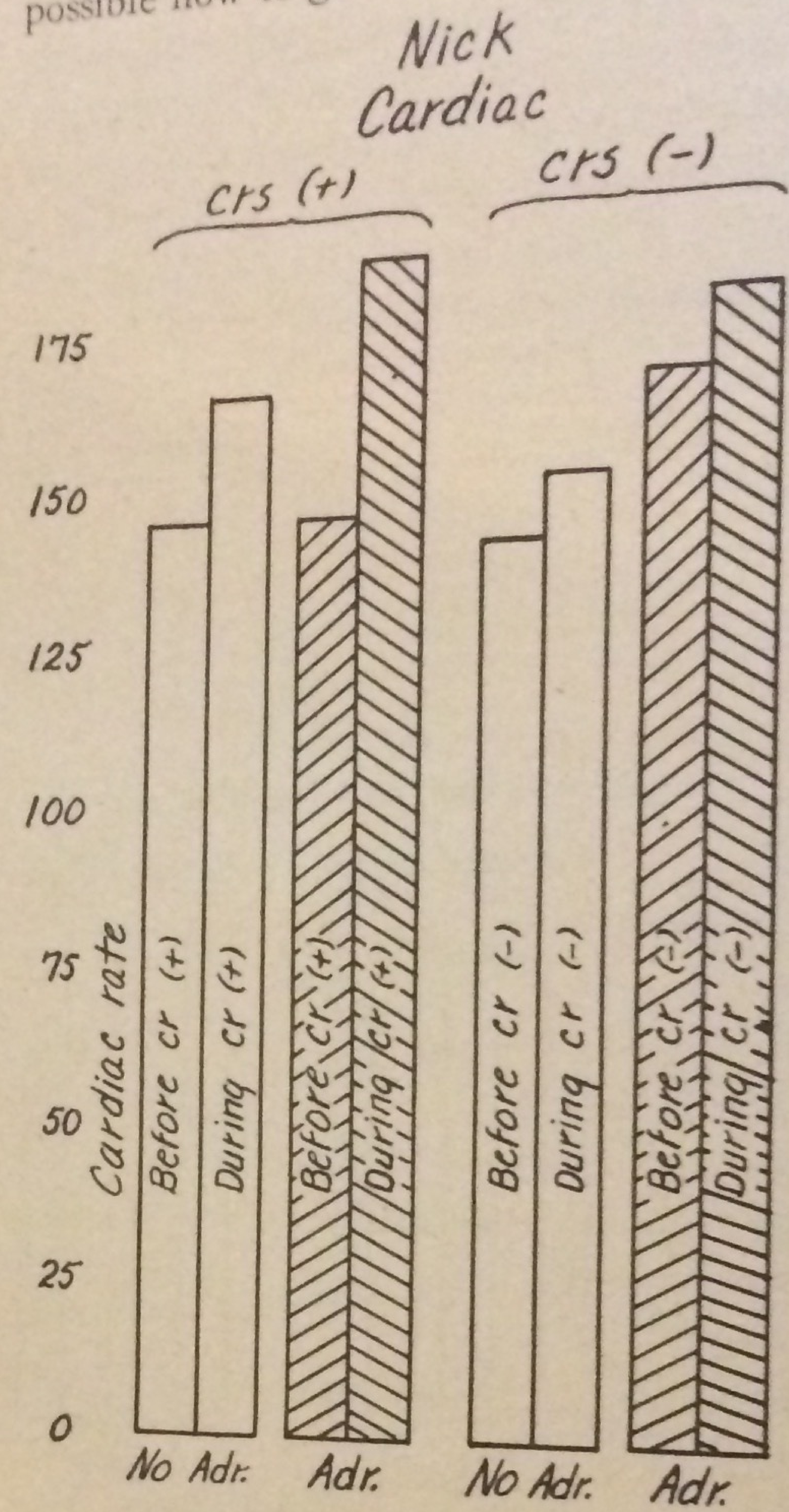


FIG. 19a. Impairment of differentiation (measured by both motor and cardiac crs) caused by adrenalin injection in labile (Nick) and stable (Connie) dogs, expressed in percent of normal.

Brooks, on the other hand, proposes that there may be in Nick a more active compensating reflex mechanism such as that represented by the carotid sinus, than in those other dogs who show increased sensitivity to the adrenalin. The fact that in animals (rabbits) with a pre-existing hyperglycemia adrenalin does not have so great an effect as when there is no hyperglycemia (Dworkin [91]) is consistent with the above explanation of Brooks as to why adrenalin does not have so much

effect upon Nick as upon normal dogs. However on the basis of the facts it is not possible now to give a definite final explanation of the mechanism.

As mentioned in Chapter VIII, variability is a measure of pathology. A comparison of the standard deviation (σ) and of the coefficient of variation (v) (*112*) in the three dogs (Table 19) reveals that v is lowest for Fritz, intermediate for Peter and by far the highest for Nick. This, as has been stated pre-



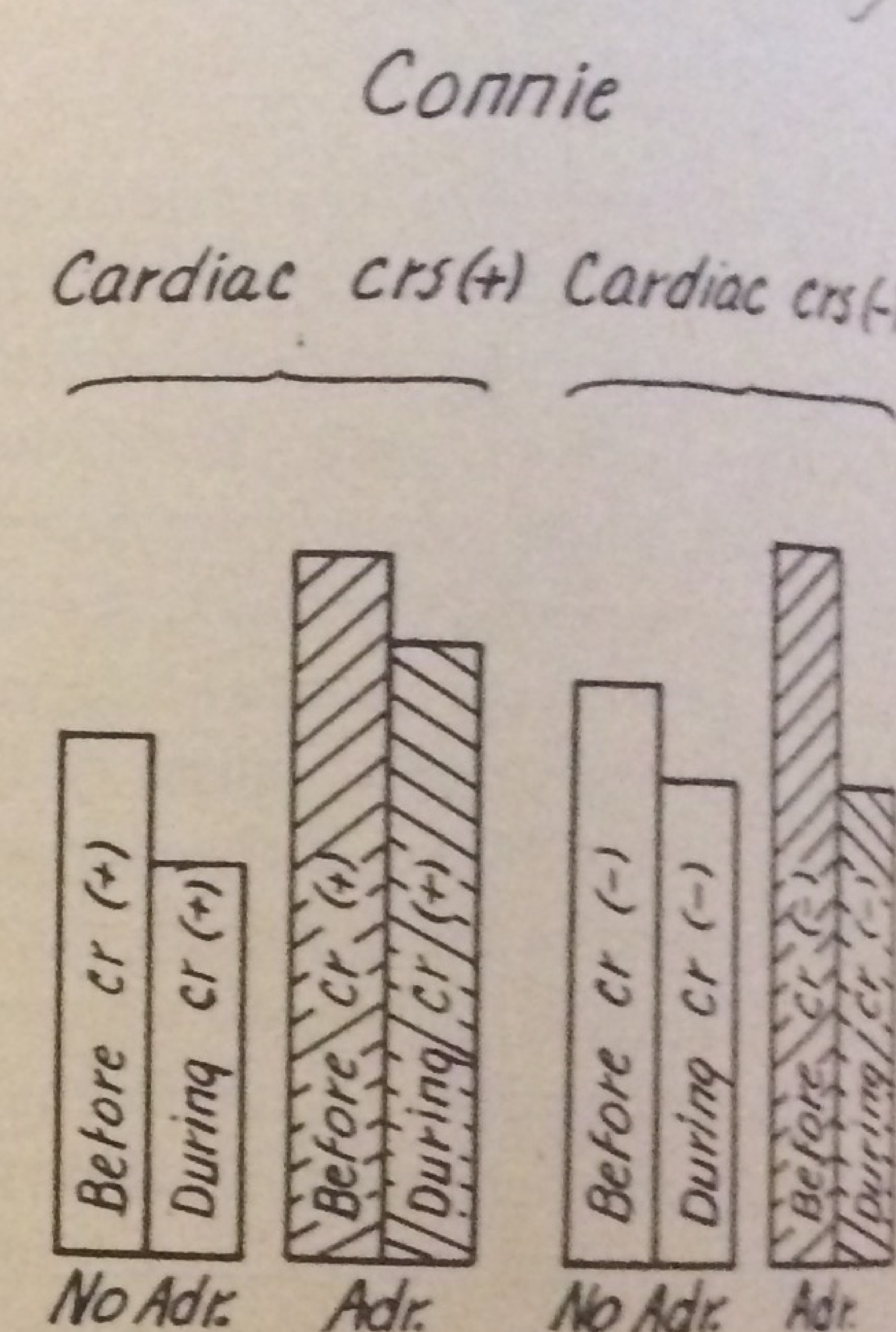


Fig. 19b. Effect of adrenalin on cardiac crs in labile (Nick) and in stable (Connie) dogs. Chart shows absolute heart rates.

TABLE 22
Rectal Temperatures

	Nick	Sechs	Vespasian
21 February 1942	101.8 F.	100.6	
24 February 1942	102.0	101.8	99.8
25 February 1942	101.3	101.5	100.5
26 February 1942	102.4	102.0	101.4
27 February 1942	101.4	101.4	100.6
Median	102	101.8	100.5

viously, is just the order in which the three dogs stand as regards their nervous stability.

Rectal temperatures of Nick and two other dogs of the same age taken at the same time (15:00) in February 1942 show that there were at this time no significant thermal differences between the dogs despite the marked variation in temperaments.

2. Gastrointestinal

In the first experiments with Nick no abnormality in his method of eating was noted. During experimentation inside the camera before the introduction of the difficult differentiation he occasionally refused to eat. As the neurosis progressed,

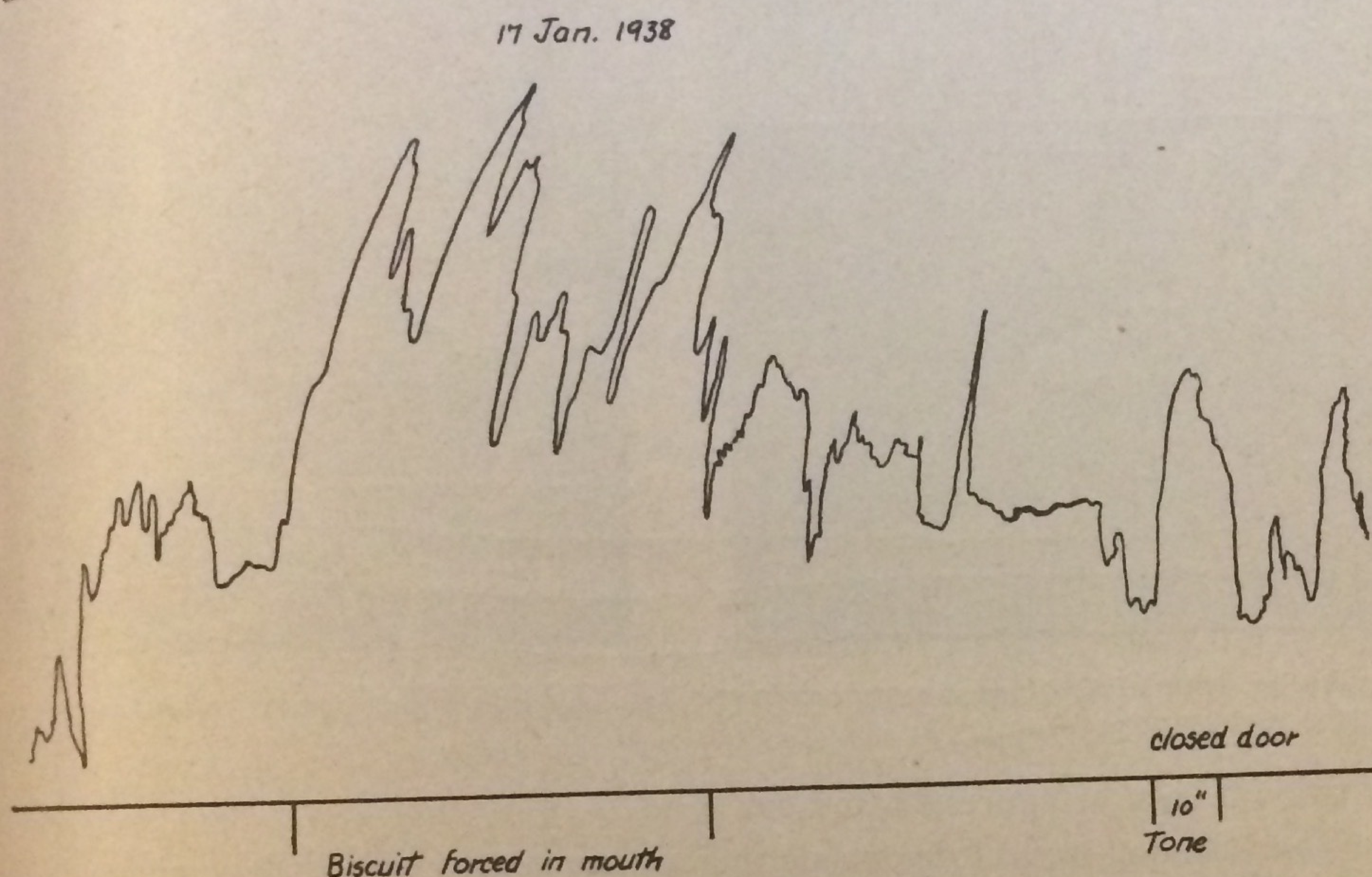


Fig. 20. Effect on respiratory response of biscuit forced in mouth. Compare fig. 21 and Table 23.

he consistently refused food inside the camera and often in the antecamera. His appetite was always good and even voracious when removed from the experimental environment—either in his paddock or on the farm. The food excitation became converted during the early part of the conflict to marked defense (or "anxiety"-like) reactions, so that the presentation of food or any of the former food csi would elicit the defense responses (fig. 20). There was usually a definite stage in the routine, such as putting the dog on the stand or attaching the leash, after which he would refuse food, turning his head in the other direction. The various stages of putting the dog in the camera apparently combined to produce complete inhibition of the food excitation. At which stage the dog stopped eating

varied slightly with his condition—sometimes it was simply bringing him into th
camera, or putting him on the table or attaching the leash; rarely would he e
after the salivary disc was applied; the strongest inhibitors were the auditory c
or even any other later elaborated associations, e.g., the light. As the procedu
was reversed—taking the dog out—the stage at which he again began to eat w
usually an earlier one (i.e., further removed from the central operation of attach
ing the disc than that at which he refused to eat) suggesting that the inhibition lasted a certain length of time after it was fully established. The negativistic reaction of Nick compared with the positive response of Fritz toward food in the same

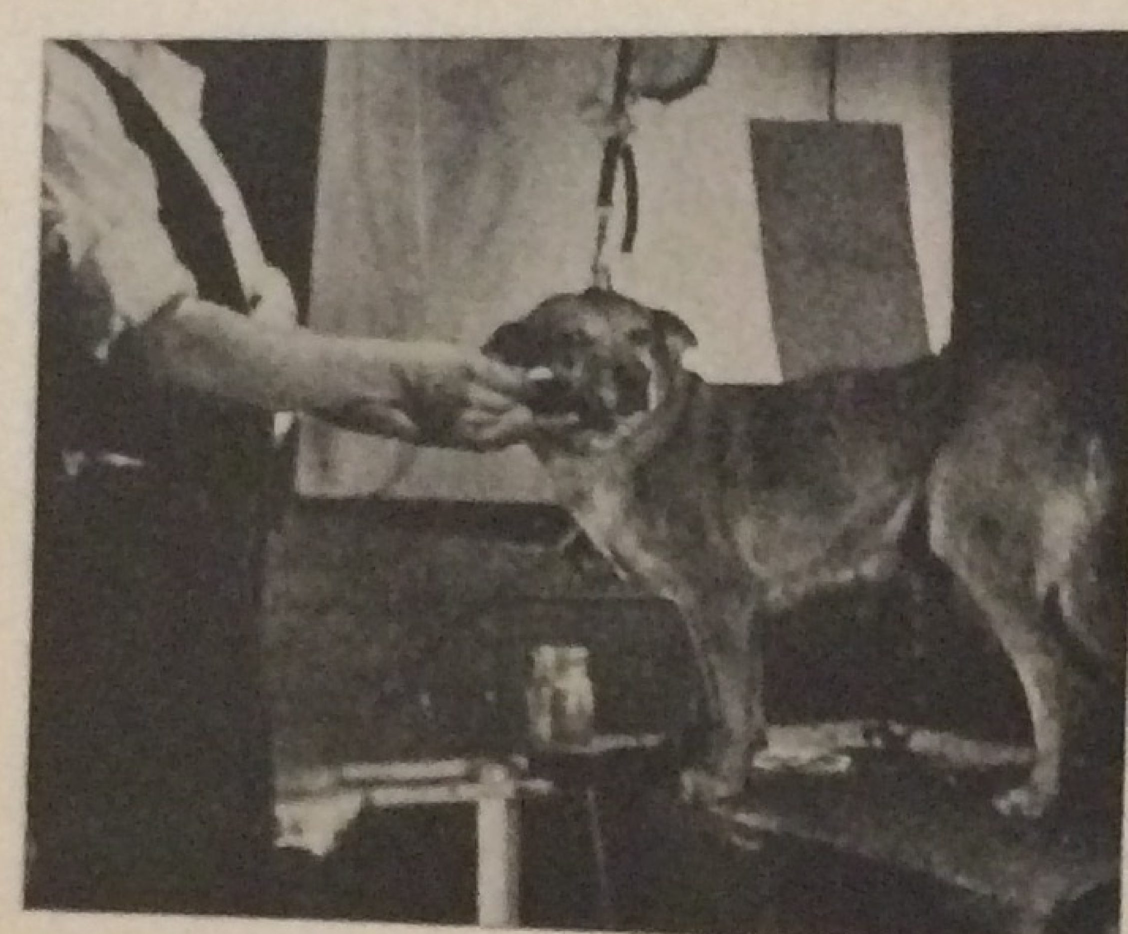


FIG. 21. Nick refusing food in camera offered by H.S.

FIG. 22. Fritz accepting food in camera from H.S.

situation is seen in figures 21 and 22.

When the dog was eating outside the camera, he was immediately inhibited and would drop the food from his mouth when any of the food csi were given from a distance, but the effect was weaker the greater his distance from the source of the signal. Frequently he picked up his food and ran about apparently playing with it, dropping it from his mouth and rolling it around. This act became stereotyped, lasting for years, and suggested the compulsive behavior of patients. The food that he received ordinarily in the early cr experiments had an even greater effect when shown to him outside the experimental environment, e.g., on the farm, in eliciting the "anxiety" and defense responses as well as the sexual reflexes (fig. 23). On 17 January, 1938 Nick's aversion to the food appeared in the respiratory movements when the food was forced into his mouth (fig. 20). Likewise Peter refused to eat the food formerly used in the situation of conflict in the camera, and was thrown into a panic of barking when he saw it, though he readily accepted

a new type of food (May 1933). Thus there was a specific aversion elaborated to the particular food used in the experiments, as well as a lesser aversion to any kind of food in the camera. The inhibitory effect of the camera was so great that it was difficult to get him to eat highly relished foods such as meat and this even though he had been starved as much as two days previously.[5] The effect of eating this meat in the camera for a period of several months will be discussed under therapy.

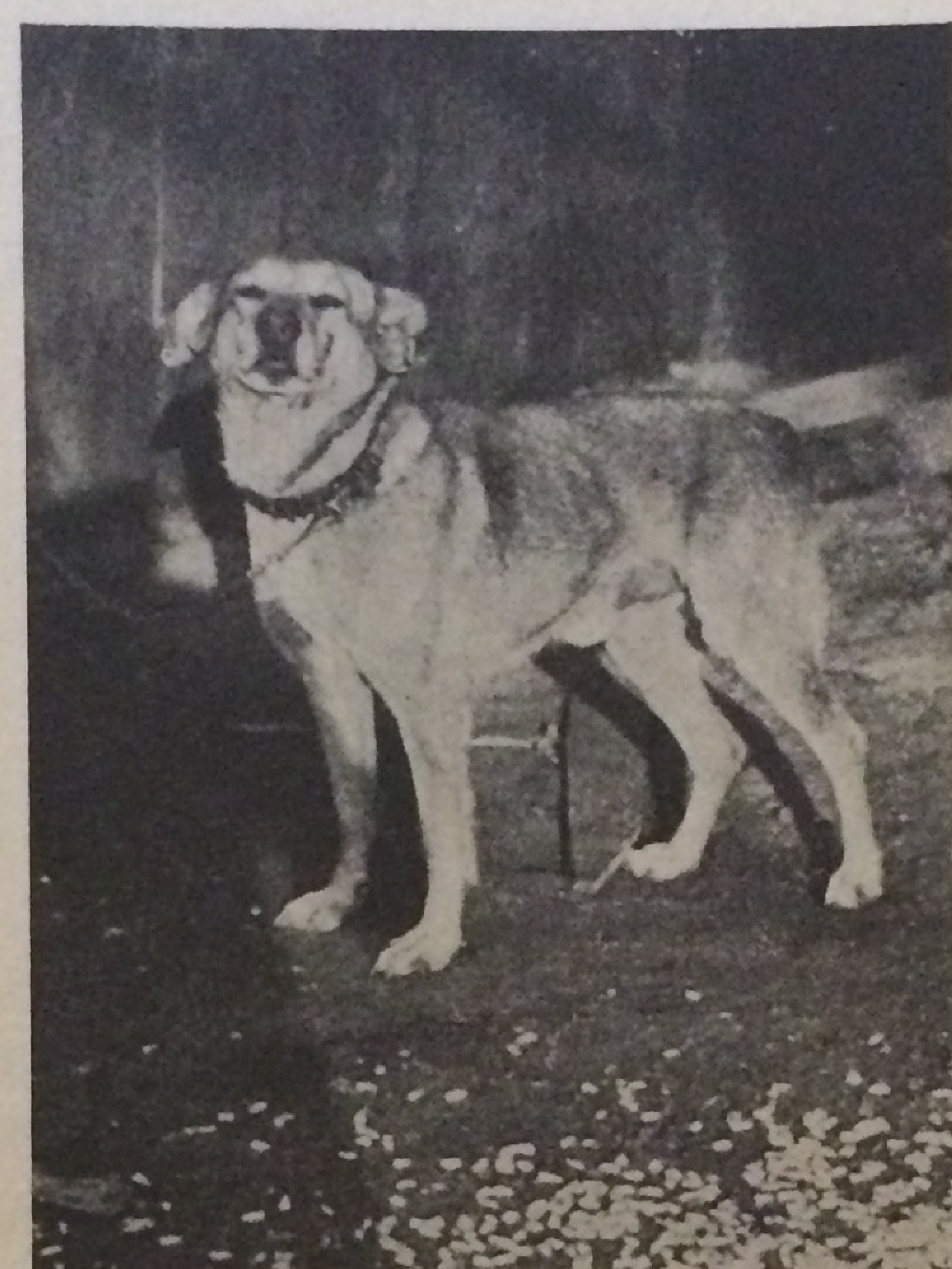


FIG. 23. Nick on farm refusing food used in laboratory—ovals on ground.

A peculiar type of defecation with the accompanying neurotic micturition and sexual erections was sometimes observed. This followed a definite pattern—spinning around pivoted on his hindlegs, followed by vigorous pawing and scratching, barking and whining. It was seen particularly in the country during the first few minutes that Nick was taken off the leash while he was excitedly dashing about, barking, whining and panting.

In many of the dogs subjected to stress a fetid odor was noticed in the camera, especially during the period when the conflict was the greatest. Unlike the pollakiuria and the sexual erections, this odor appeared during the acute stress and not later as a trace of conflict. It was observed in many dogs, but particularly in Peter and Nick. Although the source was undetermined, its resemblance to a fecal odor would indicate an intestinal origin.

Peter and Nick not only refused food but developed a marked negativism toward the food. This is seen in the movements—e.g., turning of the head away from the food, occasional retching during the tone—and also in the secretion; the parotid salivary secretion to the natural as well as to the artificial (laboratory) food csi was completely inhibited.

An example of the inhibitory effect of the environment of conflict on the parotid salivary secretion is seen in Table 23 (figs. 21 and 22).

As the csi arising from the proximity of the food (visual, olfactory) are commonly very strong, being old and natural csi, one may reasonably assume that the

[5] Masserman's cats who became neurotic from a blast of air while they were eating refused food for as long as 48 hours after starvation (personal communication).

TABLE 23

EFFECT OF CONFLICT ON SECRETION

COND. STIM. No. PREVIOUS REPETITIONS WITH FOOD	CR (AVERAGE)	UR (AVERAGE)
	Before Neurosis March 2, 1932	
Tone for 10″ 55 repetitions	0.4 cc.	0.93 cc.
	After Neurosis June 27, 1932	
Tone for 10″ 738 repetitions	0	1.58 cc.
	Feb. 27, 1941	
Met. for 10″ Several hundred repetitions	0	0.83 cc. (food forced into mouth—ejected)
Food held close to nose for 1 min. in camera	0.07 cc.	—

above pathological state is reflected in the other secretory digestive glands—stomach, pancreas, liver, intestine.

The interest of Arnold Rich in the gastric secretion in nervous conditions in dogs has provided us with an answer to this hypothetical question suggested by what I had noted in the parotid secretion. On the initiative of Dr. Rich samples of the gastric juice were taken from Nick by a stomach tube (examinations were made in the afternoon 22 hours after the last feeding). Table 24 shows the presence of a persistent hyperacidity; normal dogs, as known from the work of Pavlov, Babkin, ourselves and others have no free acid in the fasting stomach but only a little alkaline mucous.

cf [illegible]

TABLE 24

DATE	FREE HCl	COMBINED HCl	TOTAL ACID
15 Jan. 1942	40	24	64
20 Jan. 1942	40	27	67
29 Jan. 1942	11	24	35
12 Feb. 1942	0	52	52 (slight food residue)
	34	28	62
Median	34	27	62

Unfortunately earlier experiments were not done on Nick so that we cannot say definitely whether the hyperacidity is a result of "constitution" or of the induced neurosis. Anomalies of gastrointestinal secretions in nervous patients are well known. The suppression of salivary secretion and the gastric hyperacidity noted by Rich in Nick is comparable to the hyperacidity reported by H. G. Wolff (111) during emotional states in patients. The anomalies of the parotid secretion

in the presence of the conflict is a clear indication of the effect of environment of conflict on digestion; for it was at first normal and then became suppressed as the neurosis developed (Table 23). On the other hand, the UR salivary secretion, i.e., the secretion to the food after the dog has taken it in his mouth is, like most URs, unaffected or only slightly decreased by the conflict.

The anomaly of the gastric secretion, although in the opposite direction of the effect on parotid secretion, is an evidence of a widespread disturbance in the digestive organs which has extended beyond the limits of the conflict. Although the hyperacidity has not so far been shown to be dependent upon the environment of conflict, its presence is of great interest when taken in connection with other expressions in the autonomic imbalance, e.g., pollakiuria, sexual anomalies. The irregularity of the blood sugar tolerance curve in Nick is partly the result of intestinal motility; the autonomic motor system suffers as well as the secretory.

After 8 months of experimentation the food crs were almost compeltely transformed into defense; indeed the appearance of the particular food biscuit, in the camera or even outside, was often strong enough to initiate marked whining, barking and retreating seen as early as 12 October, 1932.

The inhibition of the salivary secretion is an extremely selective one, inhibiting only the secretion produced in a certain setting. It is possible to elaborate a copious salivary cr to the same tone that was connected with the conflict when this tone was subsequently used as a signal for *defense* (acid into the mouth) instead of for *food*. Hence it is evident that the inhibition is not absolute for the tone but for the tone used in a special way.[6]

The strong potential action of the tone (though no longer a stimulus for food) is proven by the fact that it can be used as the basis for elaborating other specific defense reflexes. See for example, the ease with which *Light-associated-with-Tone* becomes a stimulus for the anxiety-like reactions (Ch. VI, section 8). note

3. Respiration

No abnormalities were noted in Nick's respiration before the elaboration of crs, although he was previously brought down several times into the experimental room. Later four types of respiratory disorder developed.

[6] This fact might be taken by many as an argument against the "rigid mechanistic" attitude of Pavlov and for a more plastic "dynamic psychobiology" based upon "meaning," as suggested by Masserman (82). New terms which stimulate new thinking and experimentation, and discovery of new facts are useful. "Meaning" as a principle hardly explains any more than "conditional reflex." It has the disadvantage for scientific use of being capable of various interpretations and incapable of experimental control; the meaning may exist in the mind of the interpreter rather than in the subject. If a strict definition as an attitude or state which inclines toward or prepares for a certain line of action is given to it, as suggested by Whitehorn, the concept becomes more widely applicable. In spite of the novelty and attraction of new words let us not forget that "a rose by any other name would smell as sweet" and "that name is but sound and fury" (Goethe). note

Before describing the abnormal breathing it is well to point out the change in respiration that ordinarily occurs to the food csi and to eating. Normal animals show some increase in respiratory movements to csi but the normal changes are slight compared to Nick's. Also the greatest change in respiration in the normal comes with the UR—the act of eating—but with Nick there is a much greater change to the csi after they have ceased to be food signals. Thus compare the

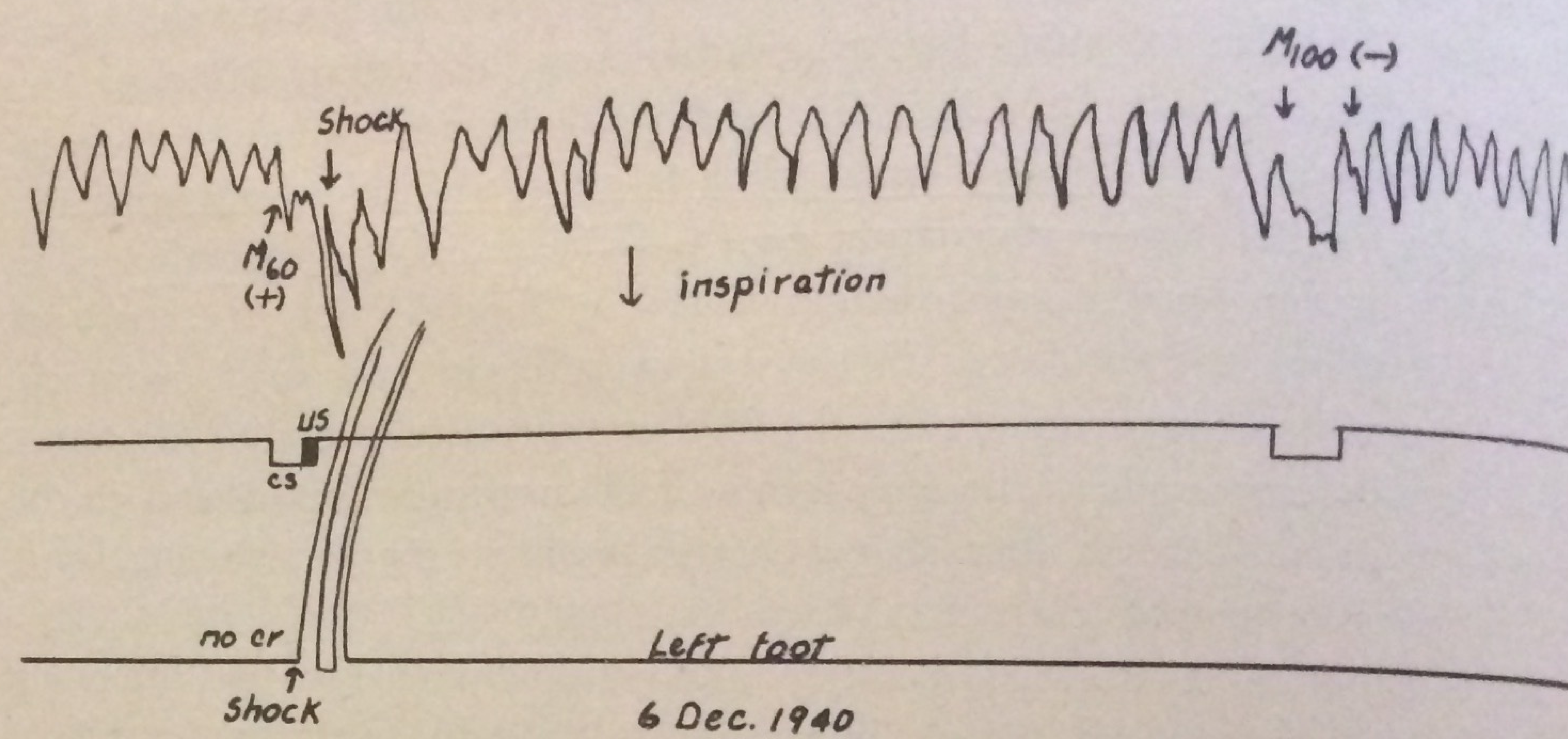


FIG. 24. Regular respiration in stable dog (C) even before differentiation (dog receives shock).

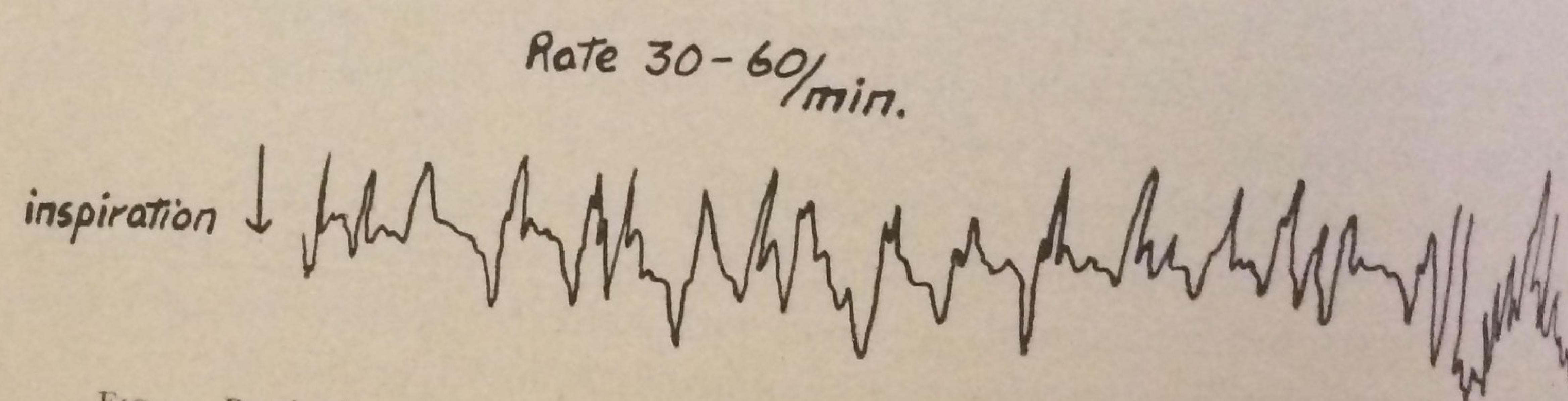


FIG. 25. Respiration of Nick 27 February, 1941, showing disturbed character. Cf. with fig. 24.

respiration of normal dogs (fig. 24) with that of Nick (fig. 25) even when he is outside of the camera.

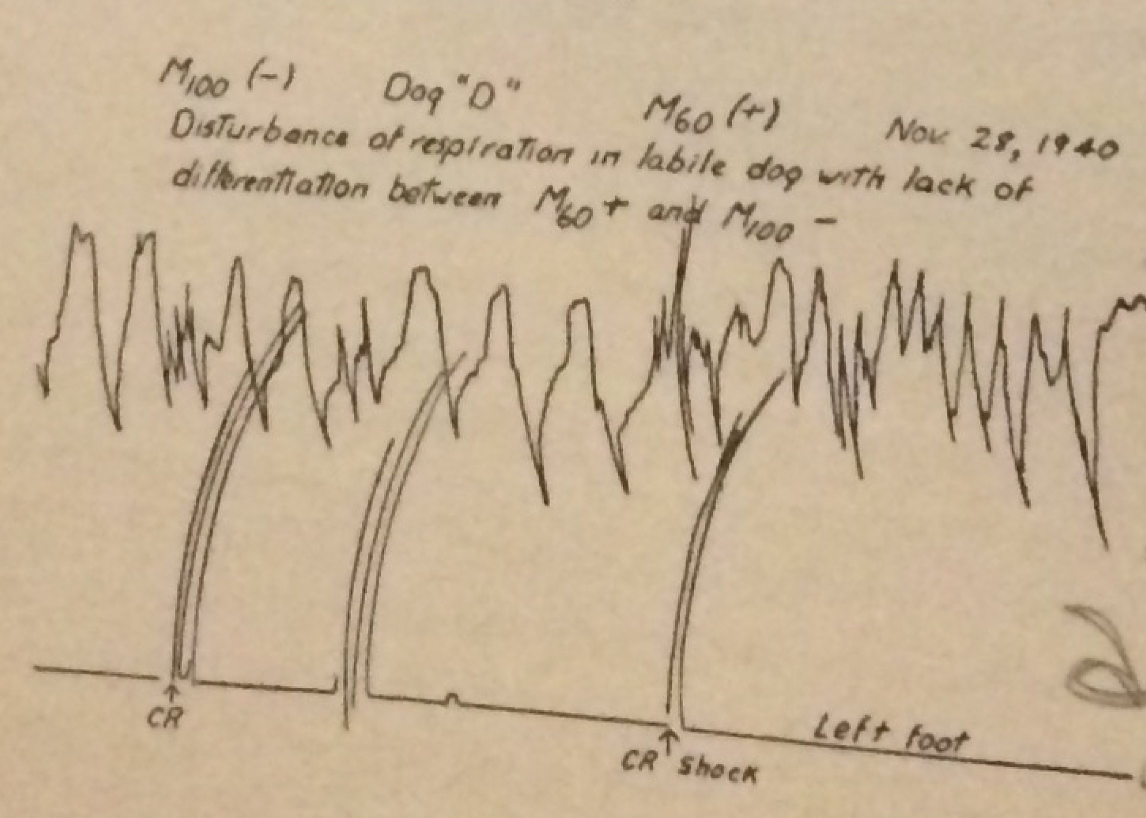


FIG. 26.

Nick's respiration is much more similar to that of an unstable dog during the cs for a painful stimulus (electric). Compare example of Nick's response (to former food csi) (fig. 13) with that of Dog D (to painful csi) (fig. 26).

The first type of pathological respiration was rapid breathing (panting) which came in the early part of the conflict and has lasted until the present, reaching

200-300 respiratory cycles per minute. The second was a definite stereotyped pattern of breathing resembling asthma superficially, and seen whenever he was excited but particularly in the experimental environment. The third was a type of respiration elicited specifically by any of the anxiety-producing stimuli used in the camera. The fourth type of respiration was a quieter one noted in the emotional states accompanying petting and often in the end stage of normal sexual excitation (figs. 33 and 34).

The rapid breathing was first noted in February 1932 in the camera. It appeared to be ordinary rapid panting occurring almost any time the dog was brought into the camera, or even when he was running about in the antecamera, or being brought down to the camera. Inspiration and expiration were smooth and regular and of nearly equal duration without the plateau effect seen in the third type.

The rapidity of 150-250 was maintained for as long as 10 or 15 minutes with only occasional and short remissions to a normal rate of 15 per minute (see fig. 25, 27 February, 1941). When anyone approached Nick in his paddock rapid breathing also occurred and was noted by ordinary counting to be 90 to 180 on 8 March, 1941 (counted by E.B.A., who had never worked with Nick, standing outside N ck's cage). Hence it could not be chiefly the result of the attachment of the pneumograph or other apparatus (fig. 27).

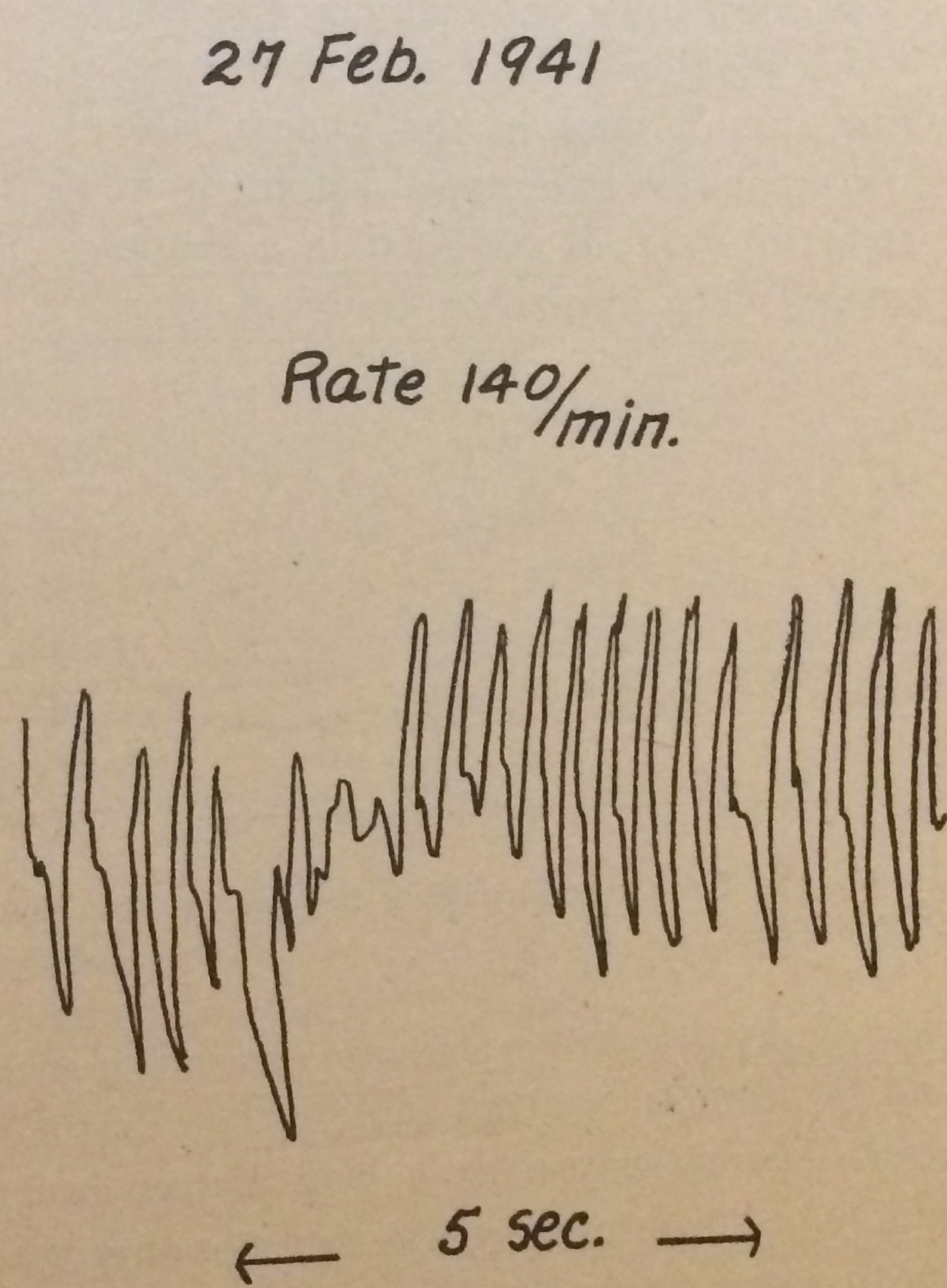


FIG. 27. Rapid (first type) respiration (140/min.) in Nick while in C.

The rapidity of the respiration was very striking (and probably near the maximum possible for dogs) and compares with upper limits in physiological states. Thus a few minutes after metrazol convulsion, a rate of 150-200 was seen (experiments of Victor Rosen and Gantt [97]); Bard (4) has noted in thermal panting a maximum rate of 400, and Kellogg (*105*) has reported 500 to 600 during panting but only for a few minutes without remissions, while in Nick the rate was 150-250 for nearly 10 minutes.

The second type of respiration was the definite stereotyped asthma-like pattern dating from 1935—several years after the original conflict—appearing whenever Nick was brought into the camera, increasing with severity as he approached the camera, but never seen in the paddock until someone who had worked with him came near. However, it was sometimes present in other situations when he became excited. This breathing was very noisy, raucous in character, audible for several hundred feet, in appearance like a slow, labored breathing, rate about 10 per minute, inspiration and expiration about equal. Figs. 11 and 12 show this type of breathing, occurring in fig. 11 after the 3rd, 4th, and 5th csi and in fig. 12 just after the 1st cs.

Examination of Nick's lungs (Dr. Murray Fisher, 1938) revealed no evidence of bronchial spasm, i.e., no musical rales as in true human asthma.

A *third type* of breathing was that which developed about 1934 to the specific stimuli used in the camera, also remaining as a stereotyped pattern from 1934 to 1941. It consisted in a single smooth deep inspiration followed by a

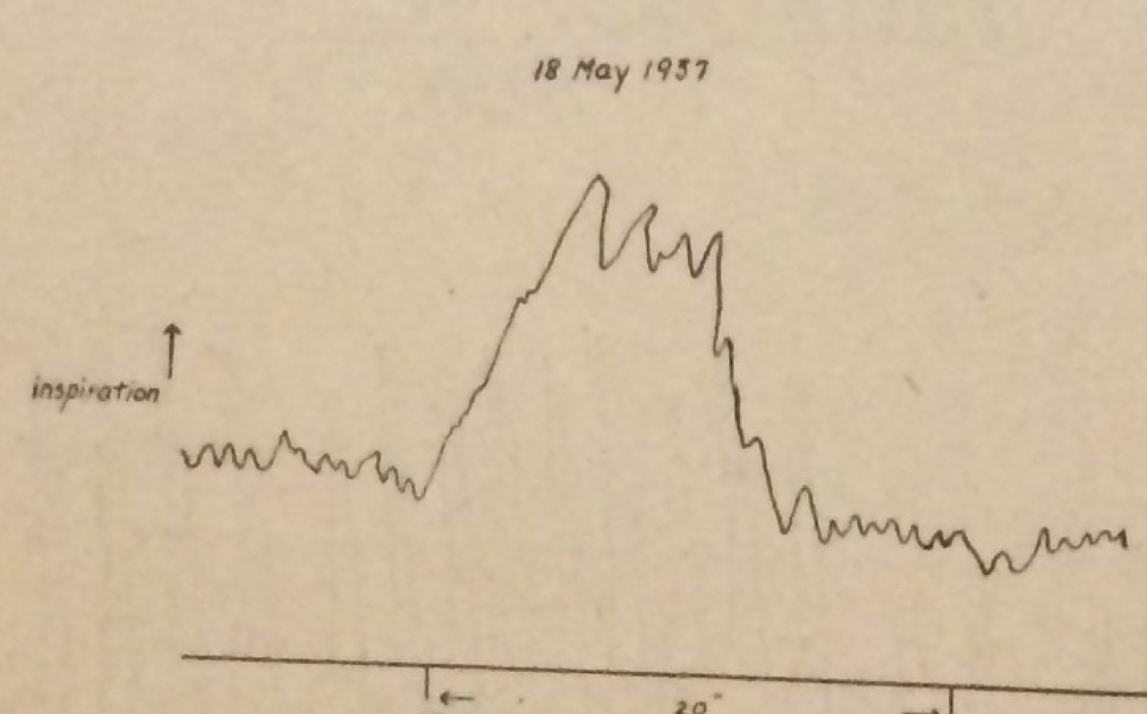


FIG. 28. Third type respiratory response in Nick to Tone.

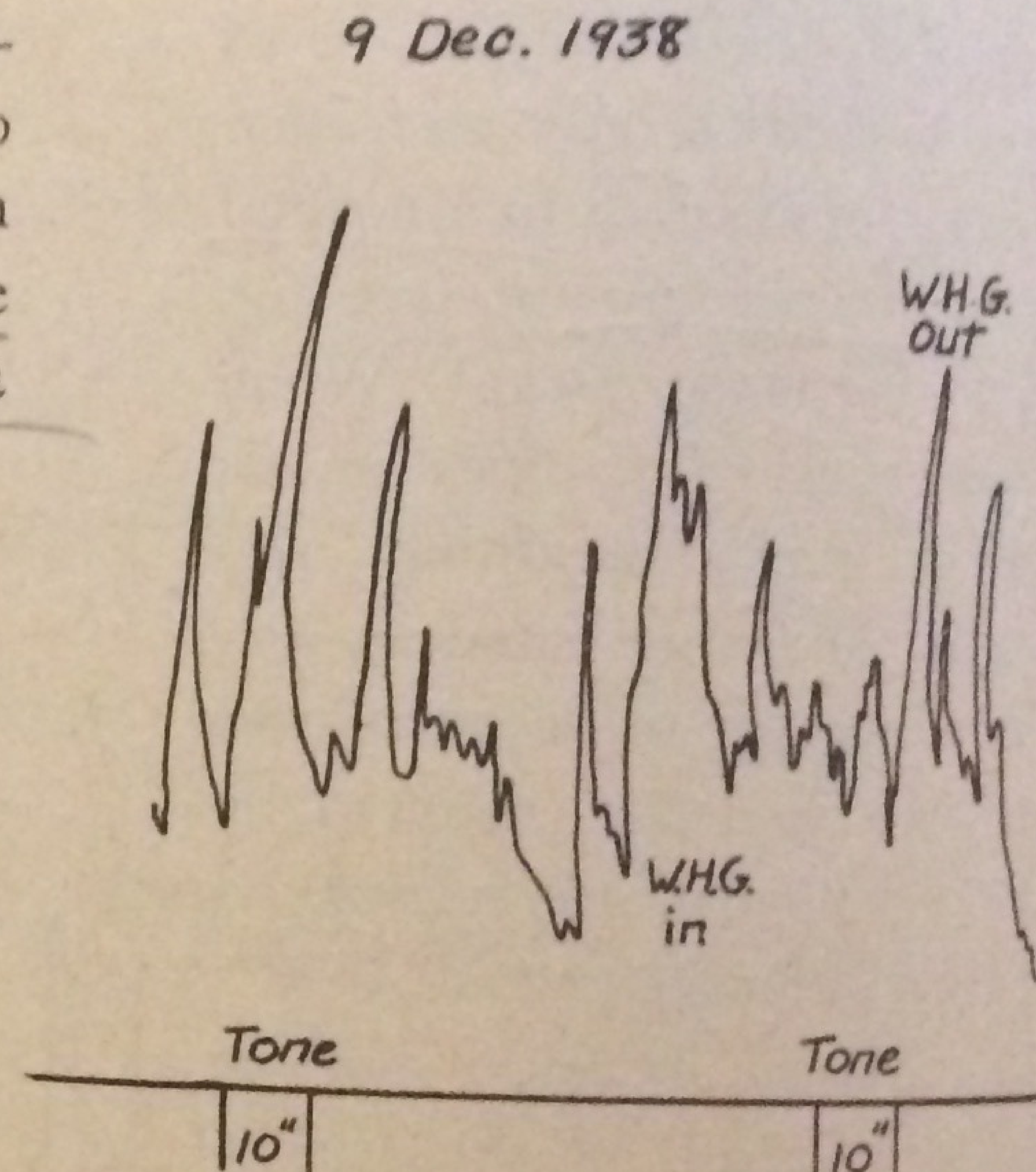


FIG. 29. Showing effect of entrance and exit of person on Nick's respiration.

slow, jerky, sometimes staircase expiration. The inspiration lasted 6 to 10 seconds, and the expiration about twice as long but it was marked by the step-like character. There was usually a long plateau broken by shallow breathing (figs. 11 and 28). This breathing was seen not only with the tone involved in the conflict, but to a variety of related stimuli, such as to the metronome, to a bubbling sound, or to almost any auditory stimulus used in the camera, even to the dropping of the food or to the entrance of a person who had worked with Nick (figs. 29, 30, 31).

This third pattern of respiration was more specifically related to the conflict than to an auditory stimulus per se. Thus in 1937 I saw that it could be developed from a previously neutral stimulus; a flashing light (L60) first used in 1937

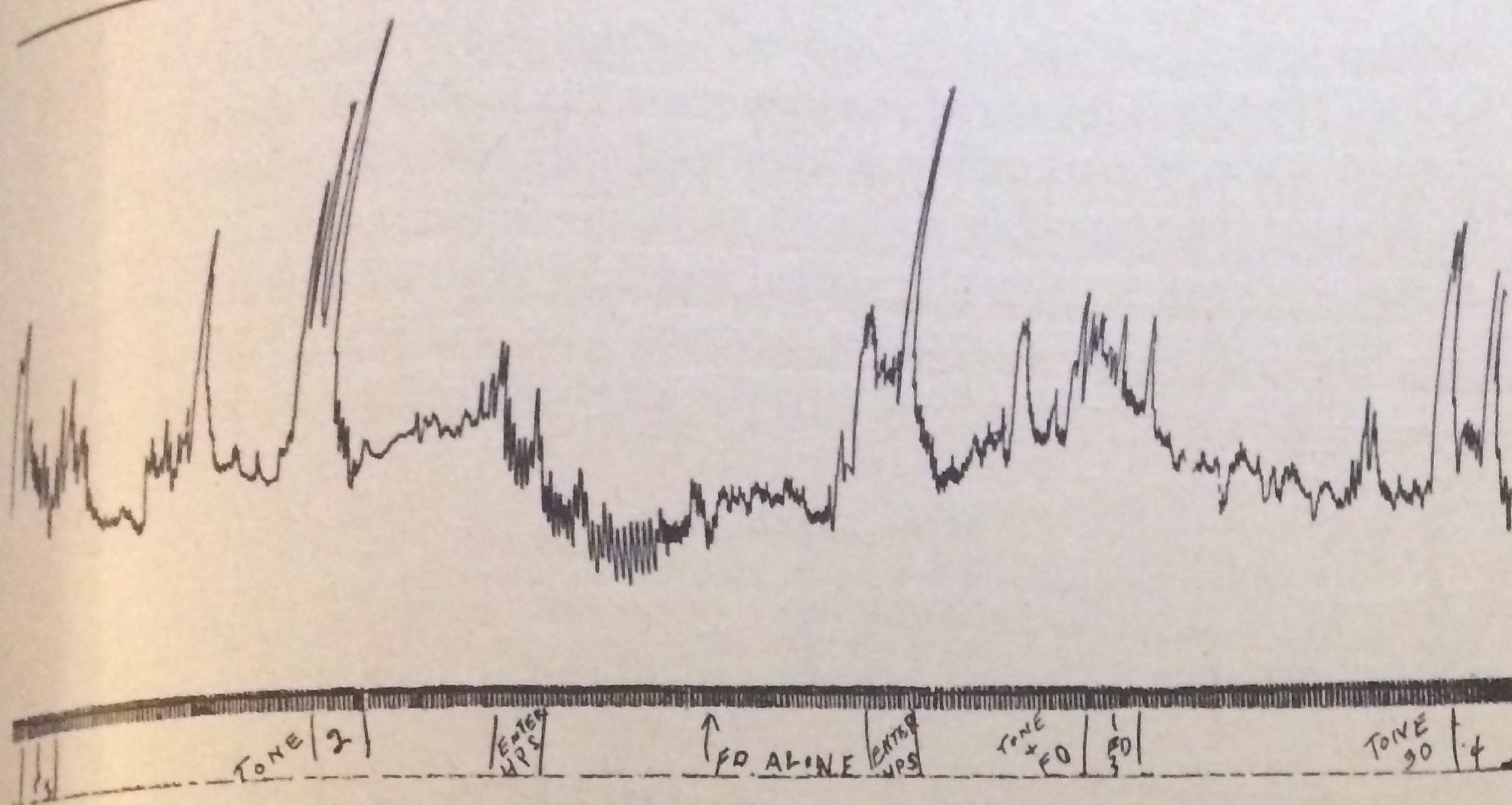


FIG. 30.

in the camera was without effect on Nick, but after combining it with the tone for 15 trials (giving the light for 5 seconds before the tone and 3 seconds after the beginning of the tone) it elicited the same type of breathing as the tone itself, with the difference that the abnormal breathing did not begin immediately to the light as it had to the tone, but only after the light had acted 3 or 4 seconds, and the reaction to the light was less stable than it was to the auditory stimuli (fig. 9).

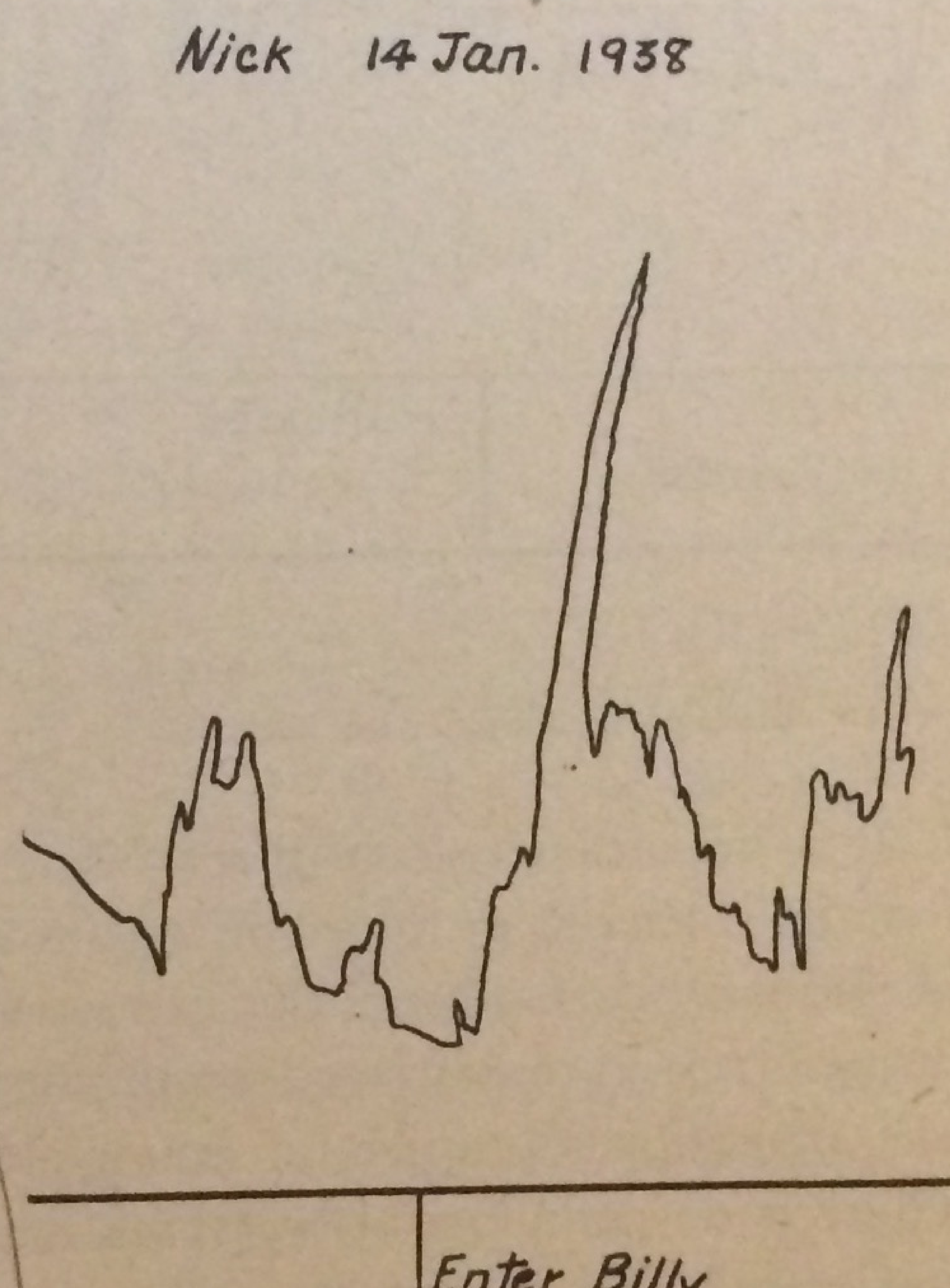


FIG. 31. Respiratory change produced by extraneous stimulus (in C) in Nick.

In comparing with other types of dyspnea the pattern of Nick's disturbance in respiration to a specific auditory stimulus, it is more similar to the type of respiration seen in the response to a painful stimulus, and is also seen in patients having anxiety symptoms (*48*). As mentioned above, to each auditory stimulus used in or near the camera, or even to the dropping of the food, Nick gave a quick deep inspiration which was held for some seconds and then expelled in short, expiratory, staircase-like stages. This is similar to the usual type of respiration seen when the animal actually receives a painful faradic shock, as has been

described by the author (*45*), and by Kellogg and Walker (*105*). Although Kellogg found this pattern of respiration peculiar to the US (shock), I have also frequently seen it as a respiratory cr in especially labile dogs besides Nick.[1] See for example the respiration in dog D on 28 November, 1940 (fig. 26).

Fig. 12 shows in contrast the second and third types of respiration, the second occurring in characteristic form to the third T cs, and the third type after the third, fourth, fifth T csi. The first type is not so marked here as in fig. 27.

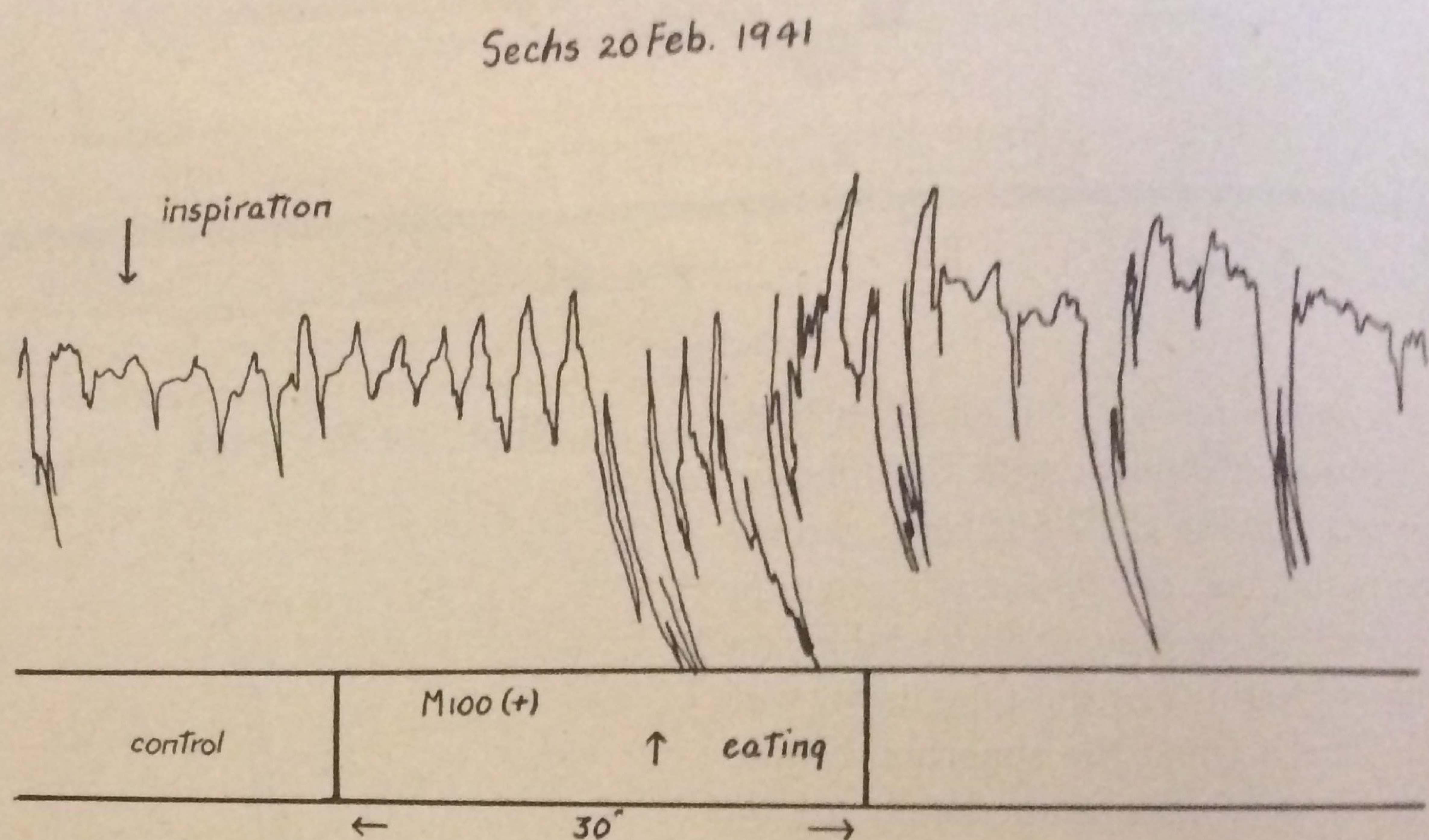


FIG. 32. Respiration in normal dog in C during cr and during UR (eating). Only slight increase in rate to M100 compared with Nick.

It is important to note that while Nick's pattern of respiration to the former food csi is similar to the respiration to a painful stimulus, it is different from the respiration to a food stimulus in a normal dog. The excitation of the food cs produces increased rapidity and amplitude of respiration, but not the prolonged step-like expiration. Compare for example the respiration in the dog, Sechs (fig. 32). There is no pathological breathing caused by M100, though the rate is slightly accelerated, and the act of eating, though accompanied by irregular respiration, does not have the pattern of Nick's stereotyped respiratory reaction.

The effect of the neurotic environment on Nick's respiration can be seen by its return to the normal after a period of rest in the country. See, for example, chart for 6 October, 1937 (fig. 10).

[1] Finesinger has reported an increase in respiratory rate with anxiety neuroses, hysteria and phobia, but little or no change in hypochondriasis, reactive depression, compulsion neurosis and schizophrenia.

Besides the abnormal types of respiration seen in Nick, there was a fourth characteristic pattern which occurred both when he was being petted (fig. 33) and during one stage of sexual excitation (fig. 34). This was strikingly similar in

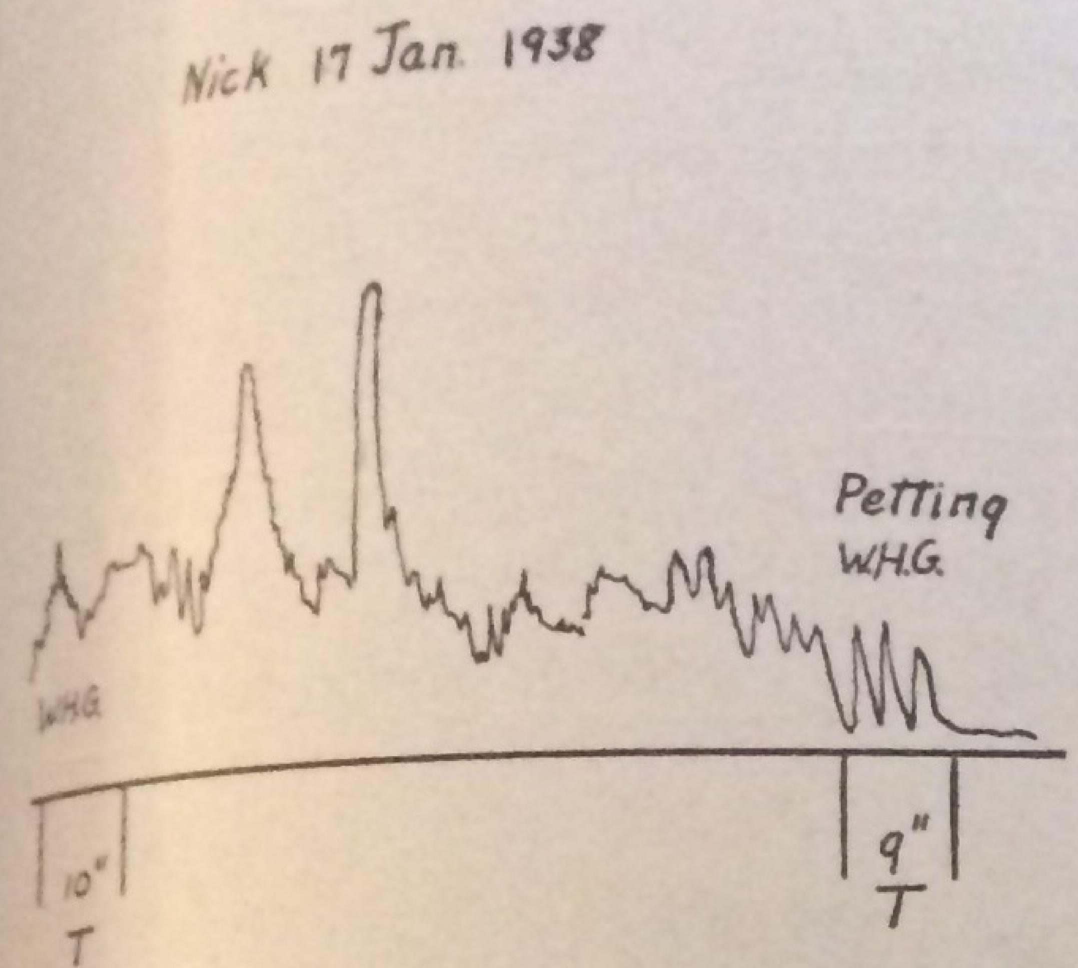


FIG. 33. Fourth type respiration in Nick during petting. Note dissipation anxiety type breathing to T and slow, regular, deep respiration, about 20/sec. Compare with figs. 28 and 34.

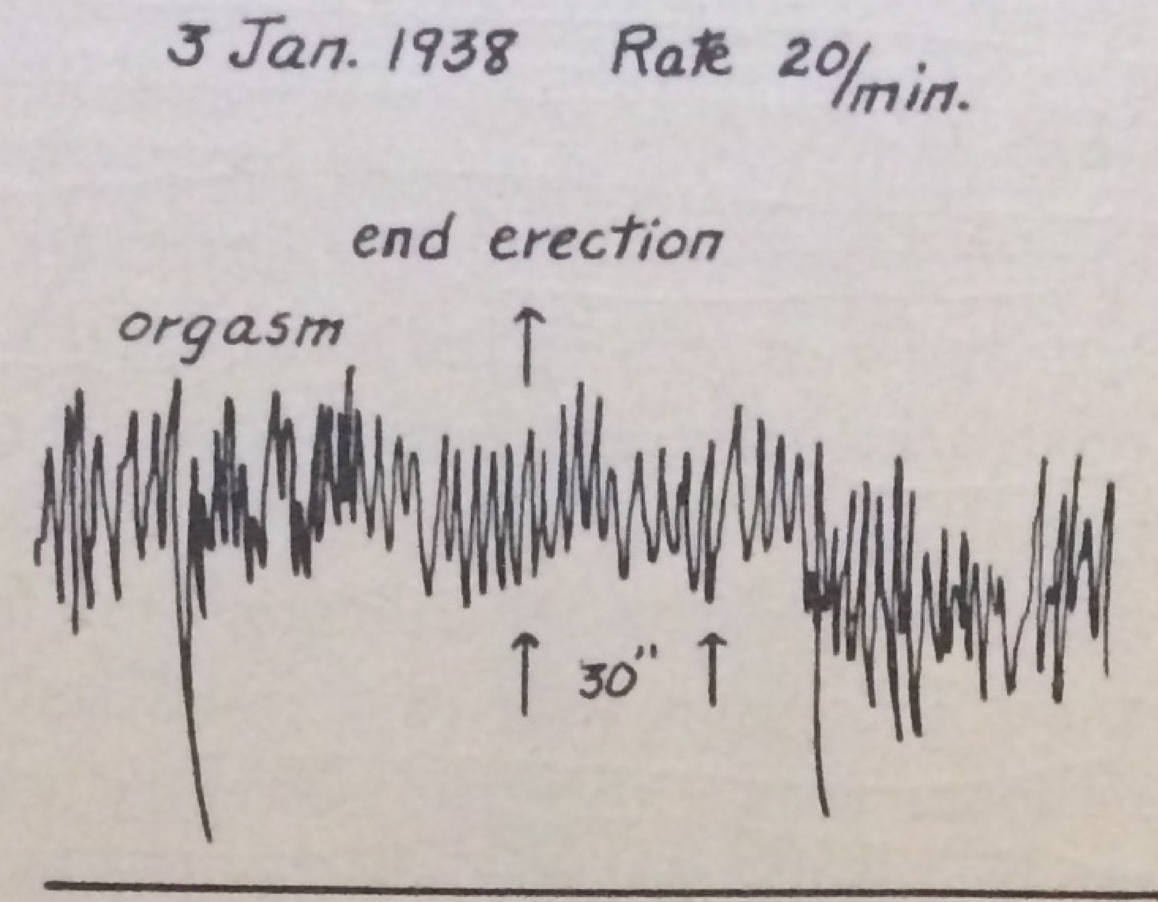


FIG. 34. Respiration in Nick during and after sexual excitation (with orgasm). Slower, regular, deep.

these two emotional states, the pattern consisting in slow, fairly deep and regular respiration both as regards amplitude and frequency. However, the respiration accompanying the pathological sexual erections was of an entirely different type, as pointed out (similar to the respiration in figs. 27 and 28)—evidence that one and the same reaction may at one time be normal, at another time pathological.

The effect of non-specific stimuli used with Nick in the camera such as opening the door and the presence of another dog Billy is similar to the pathologic respiration of type 3, as seen in the record for 14 January, 1938 (fig. 13).

Drs. French, Alexander (*28*), Dunbar (*19*), et al. have pointed out (psychoanalysis) how human asthma originates on a basis of conflict. Although the present anomalies in Nick were not strictly of the same type as clinical asthma, it is possible to see the close relation of the abnormal breathing to the stimuli of conflict, as well as to the whole environment in which they have occurred.

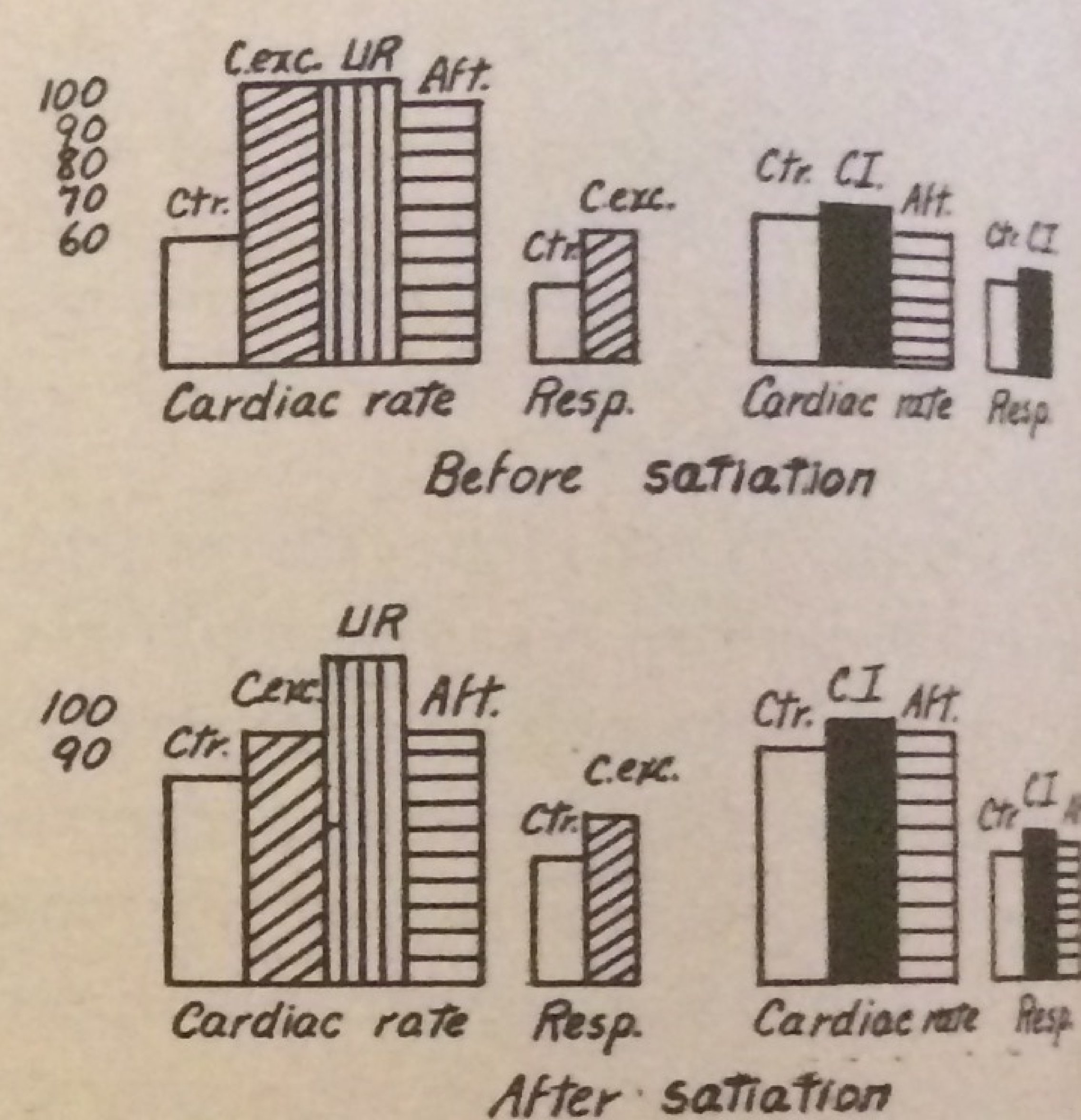
The respiratory movements recorded in these experiments are of course not a reliable index of the basal metabolism or of the gaseous exchange.

4. Cardiac Changes

Before discussing the pathological fluctuations in heart rate, it is necessary to bear in mind what are the normal relations during the cr experiment. Hoffmann and I (*42*, *46*) have shown that there is a specific change in the heart rate accom-

panying both the cr to food and the cr to a painful stimulus. It was already known (generally and also from exact experiments) that the heart rate increased with various kinds of exercise (Gasser [50], Miles [85]) and with emotional excitement (Cannon [12], Dill [16], Liddell [72], Whitehorn [108]). Our investigations revealed that there was, independently of any overt movements of the dog, a specific and quantitative change in the heart rate to the cs and to the exact amount of stimulus (food or shock) represented by the cs, and also a specific change with the inhibitory stimulus. The heart rate (cr) accompanying both the cr food excitation and a cr pain excitation is usually an acceleration, though in some dogs it is retardation.[8] In our normal dogs the change in heart rate during the 10 seconds period of the food cs varied from 7% to 30% with the excitatory cs and about half as much with the inhibitory cs (fig. 35). The cardiac cr is moreover often a more delicate as well as a more stable response than either the secretory, the respiratory or the motor cr, and closely related to the state of the animal (fig. 36). Thus in a dog (Peik) that had

Note



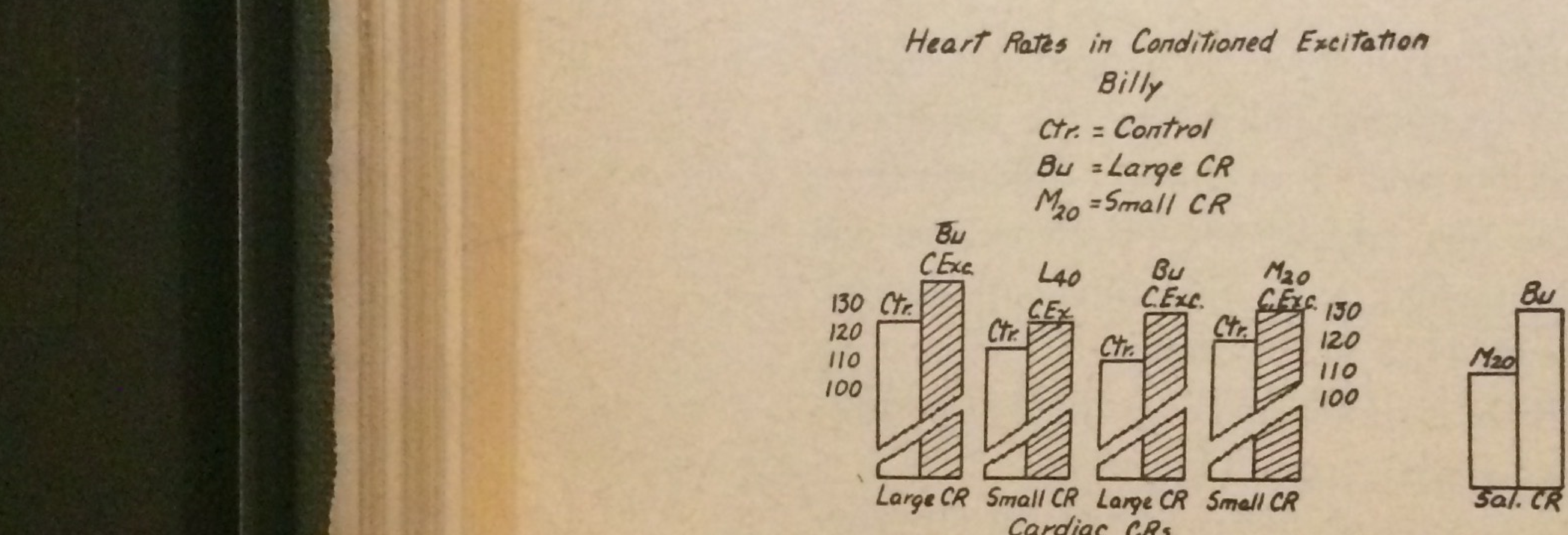


FIG. 35.

FIG. 36. Cardiac and respiratory crs in excitation and in inhibition (dependent upon state of animal). Note the smaller crs to the food signals after satiation.

been used for a year in the laboratory there was both retention and differentiation of the cardiac crs, though the motor as well as the secretory were extinguished after this interval (experiments of M. Tunick).

In the elaboration of a new differentiation in the crs, one begins to see a departure from the normal increase in heart rate which has been established to the positive cs, suggesting that an underlying emotional disturbance is involved even in simple differentiation, whether the US be food or pain. This fluctuation in the heart rate is much more marked in the labile dogs than in the stable ones. Figure

[8] We are unable to confirm the statement of Bechterev that the heart is slow with pleasurable stimulations and speeded with the sudden, startling and unpleasant. Although we found that petting of the animal in the pathological milieu slowed his respiration and probably the heart, our results agree more closely with those of Whitehorn on patients (108).

37 shows the changes in heart rate produced by the difficult differentiation in both stable and labile dogs.

This disturbance of the heart rate is usually parallel to the disturbance in the motor and secretory crs (see Chapter IV, section 2, Kompa and Peik). But in certain dogs the cardiac cr may reveal a disturbance in behavior before either the motor or the secretory do. For example, in a dog Zee, parturition, which is sometimes reflected in a loss of balance between the negative crs, produced no disturbance in the motor crs, although it did in the corresponding cardiac crs (see Table 3 and fig. 38). If the differentiation is not too difficult nor the dog too labile, the upset is not a permanent one, and the heart rate drops as soon as the differentiation is accomplished, being normal except when the conflicting positive and negative csi are given.

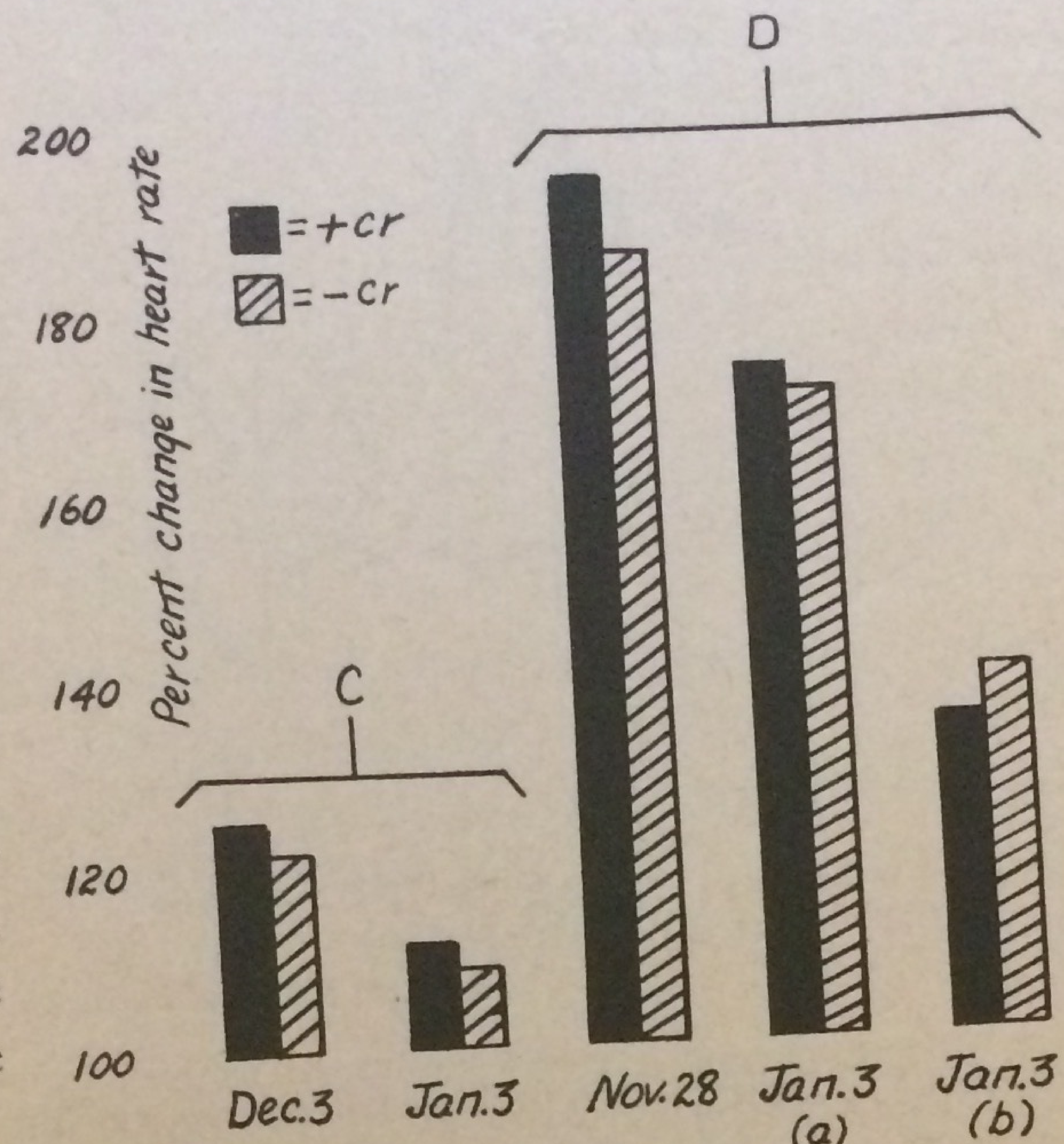


FIG. 37. Conditioned cardiac rates in stable dog (C) and labile dog (D) during strain (Nov. 28-Dec. 3) and during good differentiation (Jan. 3). Control represented as base line = 100%. a = before differentiation on 3 Jan.; b = after differentiation on 3 Jan.

Unfortunately heart rates were not taken on Nick until after the period of conflict. The first measurements were on February, 1933. On 13 February when he was in the harness on the experimental stand a decided increase was noted compared with his heart rate lying outside the camera on the floor. Even then it was striking that when the pulse was taken by H.S. the rate was faster than when taken by R.B.L. This was in keeping with his antagonistic behavior toward H.S. and the rapid change in heart rate whenever H.S. approached—seen throughout the life of the dog, as described in Chapter V.

Pulse 13 February, 1933: (after experiment) in harness in camera: 132 (R.B.L.)
145 (H.S.)
110 (R.B.L.)
106 (R.B.L.)

(after experiment) outside camera on floor: 144 (H.S.)
138 (R.B.L.)
75 (R.B.L.)
75 (R.B.L.)
123 (H.S.)

At the time these readings were made Nick was refusing all food in the camera, the secretory crs to the tones had become zero, and the behavior was generally disturbed (whimpering, retreating, barking).

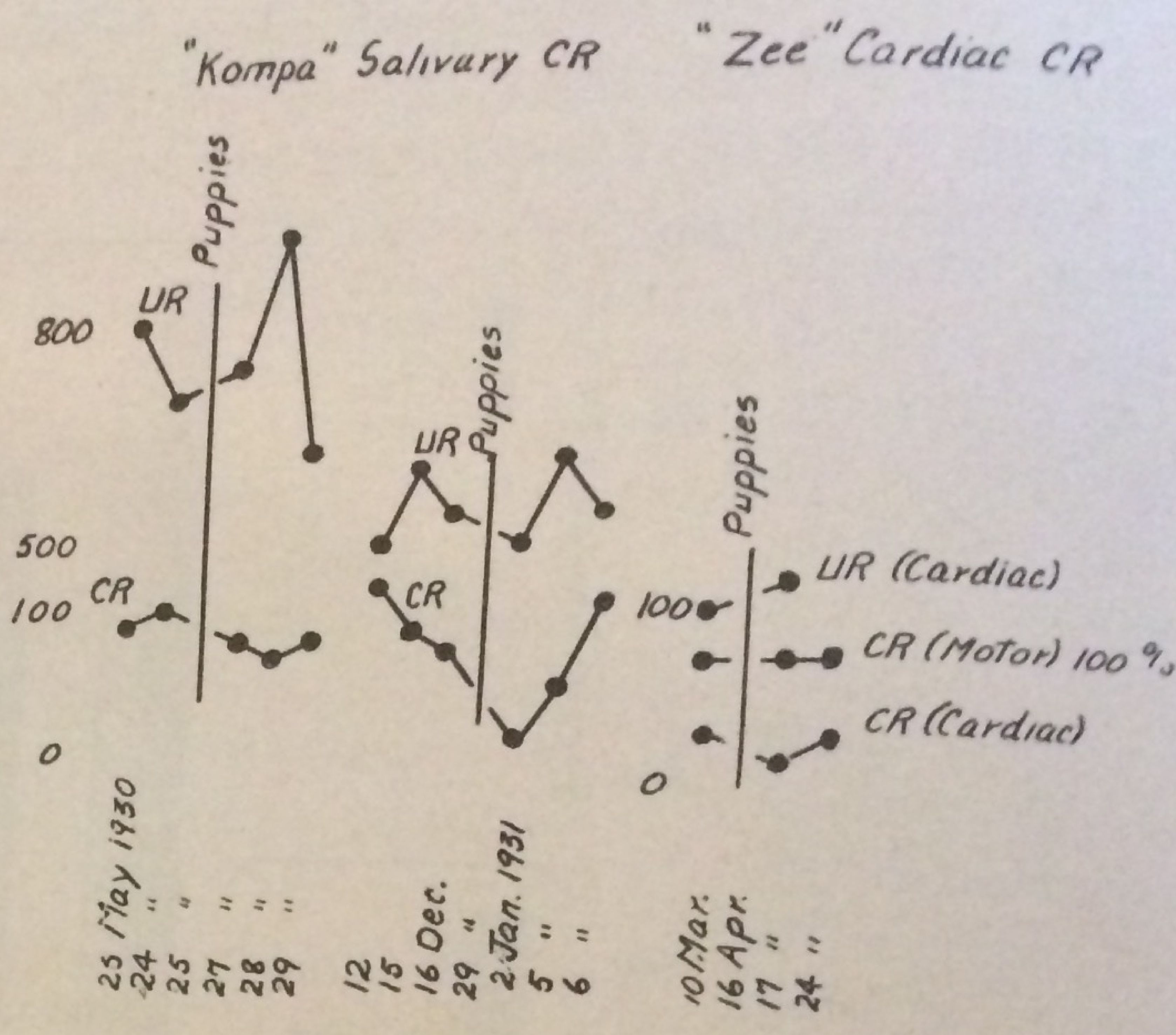


FIG. 38. Effect of parturition on cr.

On 15 February, 1933 the following readings were obtained *before* the experiment in contrast to the above which were made after the experiment in the camera.

Pulse 15 February, 1933: (before experiment) outside on floor:	87 (R.B.L.)
	85 (R.B.L.)
	87 (H.S.)
(after experiment) inside camera:	90 (R.B.L.)
	110 (R.B.L.)

On 16 February again a marked contrast was seen between the heart rates when the dog was lying down inside the camera and when he was in the supporting harness in the camera.

Pulse 16 February, 1933: (before experiment) lying inside camera:	100 (R.B.L.)
	110 (R.B.L.)
	99 (R.B.L.)
In camera with harness attached:	148 (H.S.)

The influence of both person and place is shown by the following heart rates (median of all the experiments):

TABLE 25

	ANTECAMERA	CAMERA
1933 MANUAL RECORDING	85 (R.B.L.) 123 (H.S.) 97 (H.S. petting)	106 (R.B.L.) 147 (H.S.)
1941 Electrocardiograph	90 (Nick alone)	117 (Nick alone) 90 (Nick alone) 138 (H.S. passes in view of Nick)

It is thus a striking fact that the heart rate in a nervous condition may depend upon who is taking the pulse as well as upon the environment; for the rate was 38 to 41 greater when taken by H.S. than by R.B.L. During our early experiments when we had no recording instruments the personal factor of counting could not be eliminated, but later, as referred to below, it is apparent how even the momentary sight of H.S. made Nick's heart rate jump 40 to 53 beats per minute, though only for a few seconds.

A marked decrease in the heart rate occurred when Nick's ears were rubbed, moreover even by H.S. on 12 April, 1933, though he was very restless on this day. Compare for example rate 97 when H.S. is rubbing Nick's ears after the experiment with rate 123 when H.S. is simply standing near the dog. The quieting effect was comparable to the slow, regular, respiration observed under the same circumstances.

Throughout Nick's laboratory life, after the production of the behavior disturbance, an increase in heart rate varying from 130-210, was noted whenever he was brought into the experimental environment. The tachycardia apparently resulted entirely from the reaction to the environment and was not a permanent elevation. Thus in August 1937 his heart rate taken when he was simply standing in the experimental environment ranged from 160-200, while the next day after being transported to the farm (a distance of 200 miles by train) the rate was 105-110.

While in the country the heart rate remained somewhat elevated for several months, but after he had been there a year it dropped well below 100 and was often 70-90 during the last few months he was on the farm. On 12 January, 1941, lying by my side in the country his pulse varied from 80-100. On the 16 January the day after being returned to the city his heart rate measured from 88 to 140, though this reading was made before he had been taken into the experimental room. On 27 February, the first day that he was put into his old experimental camera, the heart rate varied between 102 and 140.

Any one of the specific stimuli connected with the experimental environment caused an additional rise in heart rate. Thus on 27 February, 1941 with the metronome his heart rate went up to 152. Attaching the electrodes, as well as the

presence of a person, also caused an acceleration. Even while Nick was in the country, showing him the food used in the laboratory caused the heart rate to go up to 160, an increase comparable to the sexual reactions to the food (see Ch. VI, section 6).

The presence of H.S. continued to elicit a marked increase in heart rate as well as of respiration, as noted before. Even on 16 January, 1941 though he had not seen H.S. but once for 18 months, when H.S. passed momentarily in front of the window of the room in which Nick was enclosed, Nick's heart rate jumped from 80 to 133. The length of time he saw H.S. was not more than a second; the change in the heart rate occurred in the next heart beat after H.S. had appeared at the window and remained slightly elevated for about a minute, though the sharp rise lasted only 3 to 4 seconds. This effect of H.S. could be regularly demonstrated; at another time during the same experiment the presence of H.S. caused an increase from 100 (control) to 140 (with H.S.). (See fig. 14.)

The shortness of the latent period of the cardiac acceleration, i.e., in the next cycle, which we observed in Nick, has been reported by Gasser and Meek (*50*) in normal dogs during exercise and Whitehorn (*107, 108*) in psychotic patients.[9] Whitehorn as well as Hoffmann and I (*42*), found that the cardiac acceleration resulting from an emotional disturbance was independent of and added on to the acceleration resulting from muscular exercise and that "the degree of acceleration bears little if any relation to the amount of physical emotion." By this Whitehorn means that the topic about which the patient overtly expresses concern may not be the one which is the source of his main difficulty, though the cardiac rate is more nearly related to the real conflict. Our findings and those of Whitehorn

TABLE 26
Heart Rates During Sexual and Other Forms of Excitation
20 March, 1940

	Dog Sechs	Dog Billy	Dog Peik
Control	15:30= 87 Min.-max.	15:58=123	16:47= 75
Positive food cr	=103	=125	=118
Eating	= 80	=144	=118
Inhibitory cr			
Control	15:37= 87	16:02=112	16:51=104
Sexual excitation	15:42= 90 (80–100)	16:16=125	16:55= 95
During orgasm	=145 (120–170)	=154 (138–162)	=110
After orgasm but during erection lasting 4 min.	= 90 (85–110)	=125	=110 (90–1)
Immediately after erection	= 88 (80–105)	=123	17:01=106 (94–)
Shaking dog violently	= 84	=125	17:07= 89
H.S. in room with dog	= 95	=115	=113

[9] Gasser and Meek reported in 1914 that the increase of the pulse from exercise could occur in the first cycle following the clenching of the fist, taking only 1.09 seconds for a 25% increase in rate to occur. See Gasser, H. S. and Meek, W. J.: "A Study of the Mechanisms by which Muscular Exercise Produces Acceleration of the Heart." Am. J. Physiol., Vol. XXXIV, no. 1, p. 49.

agree that the maximum of acceleration comes certainly within a few seconds of the "psychic" stimulus.

After Nick's return to the laboratory the heart rate remained low for a few weeks, and did not show as much rise when he was in the experimental environment as it had done before. However after he had been back in Baltimore for two months his heart rate in the experimental camera again showed a marked increase.

These heart rates in Nick are in general similar to the findings of Liddell, Parmenter and Anderson (2, 3) in neurotic sheep—irregularity, increased sensitivity, acceleration under stress, ~~with normal rate at rest.~~ With Nick, moreover, either the experimenters or any element of the environment would produce a tachycardia.

After a prolonged study of many normal and psychotic patients Whitehorn (107) finds that "emotional disturbances, even of the moderate degree common in everyday life, quicken the heart."

Tables 26 and 27 show the increase in cardiac rate during artificial and natural sexual excitation in Nick as well as in the normal dogs, Billy and Sechs.

The acceleration of the heart in Nick, as well as in other dogs showing a difficult differentiation, is much greater in the situation of conflict than it is in more natural emotional disturbances. Compare, for example, Nick's pulse rate in Table 27 to the presence of an aggressive male bulldog growling at him and almost allowed to touch him, and again that of a cat clawing and spitting at him when placed on his back, or the faradic shock to the foot, with the accelerated pulse during the tone, or any elements of the environmental conflict.

Note— to this

TABLE 27

12 September, 1939	Control	Growling Dog	Cat Clawing Back	Sex. Stim.
	100	133	100, 120	130
16 April, 1942	110	cr+	UR (faradic shock)	Conflict
			119	165

The notable increase in Nick's heart rate as well as in other labile dogs to the situation of conflict over the rates to the presence of real danger (growling bulldog, clawing cat) is evidence of the greater effect of the former; the highest heart rate observed in the camera, was 205, to the bulldog only 140, and to the faradic shock only 130.

Menninger (84) states that hypertension in patients is due to an unexpressed aggressiveness, for which he prescribes exercise rather than rest.

It is of interest here that when the tone which represented conflict in Nick was made in the spring of 1942 a cs for a faradic shock, Nick's heart rate in the camera

Note

dropped to about 110, and the rate increased during the faradic shock only to 119.

The change in Nick's heart rate under strong emotional stimulation, e.g., in sexual excitation was not so great as the acceleration produced by the situation of conflict.

Our studies of the cardiac response of normal dogs to both painful and food stimuli show a wide variation according to the individual. The latent period may not be proportional to heart rate. Hence it is clear that the heart rate can not be taken as an absolute index, but together with other measurements it helps to give us a picture and insight into the conflict.

Summarizing, the heart normally shows a quantitative relationship to the intensity of the US and a specific regular change to both excitation and inhibition, similar to the quantitative relationships existing between the salivary cr and its US (amount of food). On the contrary, the change in heart rate to pathological stimulation is chaotic and perverted—without reference to the original significance of the stimuli. It forms part of the picture of the unstable animal under stress wasting itself by internal friction instead of giving an adequate, regular and quantitative response.[10]

5. Urinary Symptoms

Although the pollakiuria of male dogs is a normal canine habit, it is so unusual for a dog to urinate in the experimental environment, that this symptom is of especial significance. Working with a large number of normal dogs for 15 years, though they might be kept on the experimental stand for 7 or 8 hours at the time, I do not recall a single instance of micturition during experimentation with a normal animal.

Of the several neurotic animals, Nick is the only one that has shown this persistent pollakiuria, although signs of great restlessness appeared in Peter and to a less extent in Fritz under identical conditions of stress. In postpartum female dogs I have noted explosive defecation and urination immediately after the stress of a difficult experiment involving a painful stimulus.

During the year prior to experimentation in Nick no instance of micturition in the camera or antecamera was observed. It is of especial interest that the pollakiuria did not begin during the period of excessive stress (1933) but after he had been absent two years or more from the active work of the laboratory in 1936—nearly 3 years after the period of acute stress. The pollakiuria became prominent about the time that the dog in estrus was first brought into the camera with Nick, and

[10] It is possible that the apparent chaos is due to the lack of our ability at present to make quantitative measures of all the factors in the pathologic situation, but it seems more likely that the pathologic response, involving an organism under *excessive* strain, beyond the ability of the animal to react appropriately, is characterized by variability, just as are many other pathologic reactions.

has persisted until the present, appearing whenever he is brought into the experimental environment, or when *elements* of this environment are present, such as when H.S. approached him even when Nick was on the farm.

The severity of this symptom after 1936 was in general parallel to other symptoms of the disturbance. The worst period was 1936 and 1937 before he was taken to the farm. The record was about 30 times in 25 minutes (1937) while running free in the antecamera. Punishment was entirely without effect; after whipping he would run to another part of the room and urinate immediately. Pollakiuria began even in the elevator and the corridors when H.S. was bringing him toward the experimental environment. Note

The symptom is apparently connected in some way with the pathological sexual excitation. It is probable also that it is an expression of natural sexual excitation in Nick, as it was enhanced by the presence or even the olfactory trace of a female in estrus.

After the two months' rest in the country and subsequent return to the laboratory, pollakiuria in the experimental environment reappeared (13 October, 1937). Sexual erections also first appeared in the same period.

Rest on the farm ameliorated these symptoms, particularly while Nick was in the country, but also after he was returned to the laboratory. During the first part of the 18 month sojourn on the farm (1938) pollakiuria still occurred when I brought Nick into the house with me, but toward the end of the period it disappeared—for the first time in 3 years—even though Nick was in the room with me; at the same time he was perfectly quiet and showed no evidence of disturbances.

Although after returning to the laboratory in 1941 Nick has shown great improvement in this respect, the symptom has reappeared, and has been at times pronounced though not so much as previously. The trace of a female in estrus nearly always evoked micturition—several times in the spring of 1941 and on the *experimental stand*. This is an extraordinarily rare manifestation for even a neurotic dog.[11]

Most events which incite the general restlessness also aggravate the pollakiuria; as in the instances on the farm when he went through painful experiences, such as being dragged a distance by catching his foot in a tow chain (1937).

Enuresis (Hamill [52]) is a frequent symptom of nervous disturbance particularly in children, a fact which the Freudians have emphasized. It is often noted in children as a result of punishment or frustration; a colleague told me that it occurred in his 5 year old girl when a sister was born; English children sent to the country and separated from their parents have been reported as frequently enuretic (Partridge, M.B. [91]).

[11] Dworkin (*21*), Masserman (*83*) and others have reported abnormal micturition in cats.

Pollakiuria is a sign of sexual excitation in normal dogs, e.g., see the note for 27 October, 1942 where the behavior of a normal stable male (Bamech) in the presence of a female in estrus was almost identical with that of Nick in the situation of conflict.

The close association of pollakiuria and erections in Nick in the environment of conflict would also be easily comprehensible on the basis of the proximity of the centers controlling the two acts and the involvement of the genito-urinary as well as the cardiac, respiratory and related centers during a state of general autonomic spread such as occurs in Nick.

The psychoanalytical evaluation of pollakiuria, defecation, erections as aggressive reactions is supported to a certain extent in Nick by his urination on the food used in the experiments to produce conflict. An alternative explanation is that outlined by Ischlondsky: that the spread to the autonomic system occurs on a physiological principle of proximity and that later (perhaps during psychoanalysis) the act is associated with aggression, somewhat similar to the process of rationalization.

6. Sexual Symptoms

The appearance of the pronounced sexual manifestations and the reciprocal relations to nervous disturbances constitute a definite and important chapter in experimental neuroses. Sexual excitation as an expression of nervous disturbance has been seen in several of our laboratory dogs, but most prominently in Nick. They may occur either during the actual period of strain, or may be absent then and occur months or years later from the trace of the conflict.

The sexual manifestations may be summarized as follows: 1) the environment of conflict, including the isolated elements of the environment as well as the people involved *provokes abnormal* sexual excitation; 2) conversely, the effect of the environment *inhibits normal* sexual function produced either by artificial or by natural stimuli; 3) paradoxically, the effect of natural sexual excitation—as well as human companionship—*dissipates* the neurotic manifestations as well as the artificial crs; 4) *reciprocal time relations* are seen between sexual excitation and other physiological excitations, such as food excitation; 5) neurotic sexual symptoms are chaotic in character (irregular, etc.); 6) *pathologically conditioned sexual excitation* differs from the normal sexual crs.

1) *Sexual excitation as a manifestation of the nervous* disturbance was first forced upon my attention by the persistent appearance of the sexual erections in Nick when he was brought into the environment of conflict. Since this time I have noticed such erections in several other dogs. In the frontispiece and in fig. 39 Nick is seen giving a typical anxiety-like reaction with marked erection to a tone used in the camera in 1938.

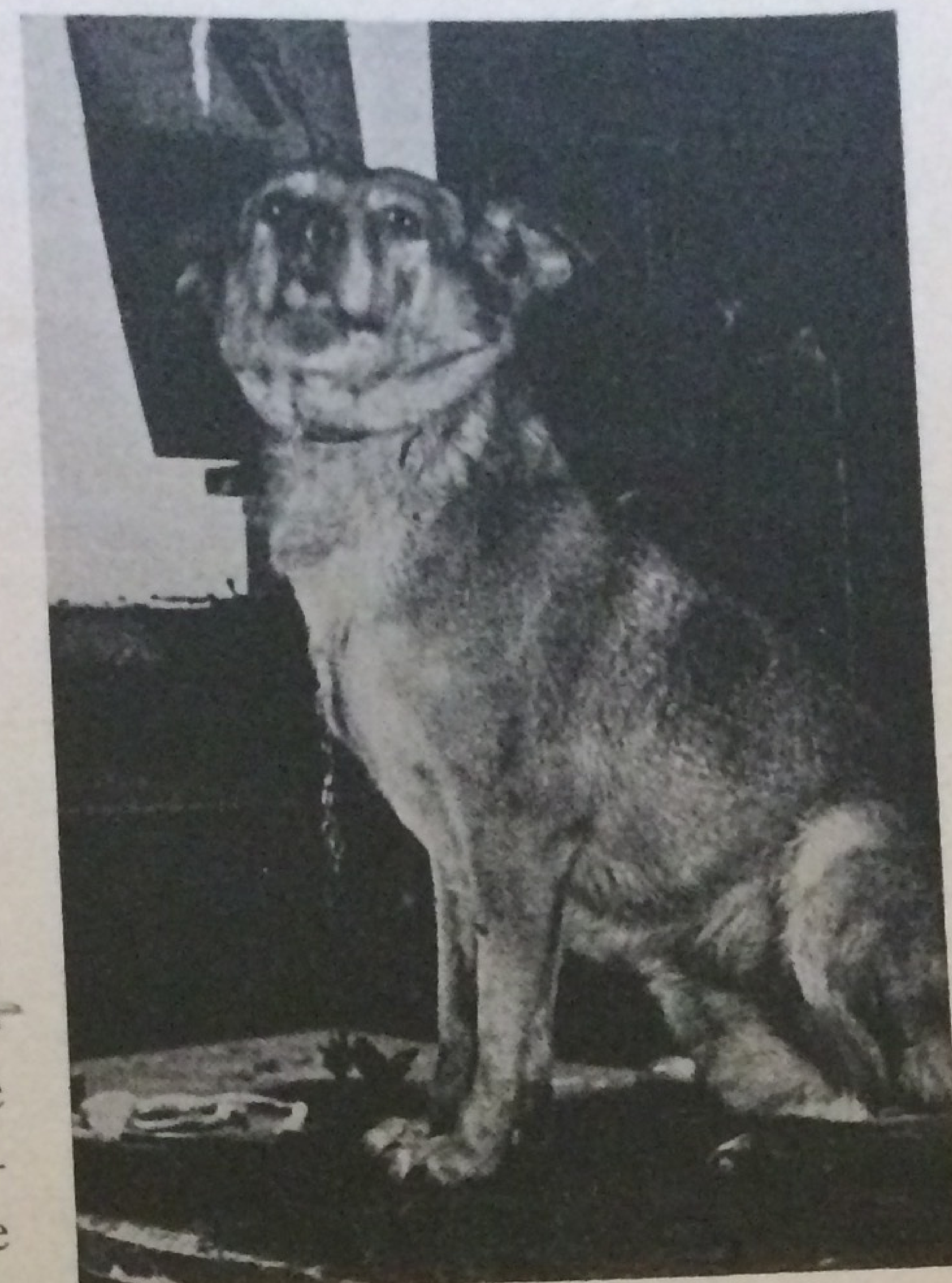


FIG. 39. Nick during tone. Note the anxiety-like facies, with labored breathing, tugging on leash, sexual erection. Cf. fig. 8.

An occasional sexual erection can be observed in normal male dogs under certain circumstances, particularly during the spring, also in young or timid animals when frightened or when a stranger approaches or in the experimental room. Such erections, however, are of short duration, appearing irregularly and infrequently, and are markedly different from the persistent and chronic sexual erections in some neurotic animals.

As pointed out in the chapter on Constitutional Reaction Types, the appearance of sexual erections is dependent not only upon the situation of stress but also upon the individual. Thus Nick was the only one of the series of three dogs subjected to the same severe stress who gave the pronounced change in sexual symptoms (as well as in other physiological systems). That it has been possible to see in several other dogs, however, that sexual changes occur with stress is evident from the following example.

Connie whose stability was marked, in contrast to Peik and Nick, began to have sexual erections when brought into the environment where the differentiation had become difficult or impossible.

Connie: On 12 November, 1940 elaboration of crs to bell on the basis of induction shock to foot was started; he formed this cr after three trials; became stable after 20 trials. On 19 November M100 was introduced as a negative cs (not accompanied by shock); stable differentiation was immediately formed. On 25 November M60 was introduced as a positive cr to be differentiated from M100; stable differentiation followed almost immediately. This dog is of the stable type, judging by records of respiratory and cardiac crs. On 27 December the positive and negative metronomes were brought closer together (by changing the positive from M60 to M69); a stable differentiation was quickly formed. On 13 January, 1941 M69 (+) was replaced by M88 (+) with stable differentiation. In two weeks M88 (+) was substituted by M92 (+) with stable differentiation by position but not by absolute frequency of the metronomes. In February the effect of benzedrine was tried on the motor as well as on the sexual reflexes. In March M88 (+) and M100 (—) were differentiated by frequency as well as by pattern.

When the differentiation became too difficult, so that the dog gave identical

reactions to both the excitatory and inhibitory metronomes, sexual erections began to occur, and continued as long as there was difficult differentiation.

On 10 March, 1941 M96 (+) was introduced, there was poor differentiation [M96 (+) from M100 (—) is a well-nigh impossible differentiation]. On 14 March *sexual erections* were first noted in Connie when he was brought into the camera, although he had formed no cr erection to the elicitation of sexual URs in February (on the 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15th). Sexual erections on bringing the dog into the camera were observed on the following days: 15, 20, 21, 25, 26, 29, 31 March, 1, 2, 3, 4, 5, 8, 9, 10 April; at which time was started the study of metrazol on crs. During all this period the animal had failed to differentiate between M96 (+) and M100 (—) hence on 19 March M96 (+) was replaced by an easier differentiation viz., M92 (+) which was also not differentiated. While metrazol was being used on alternate days, and M92 (+) and M100 (—) continued, sexual erections occurred when he was brought into the camera but less frequently (experiments of Dr. Victor Rosen).

Experiments on differentiation M92 (+) and M100 (—) continued until 5 June, 1941 without success, however; the introduction of 10 metrazol convulsions in this period during April and May apparently abolished the abnormal sexual erections.

In contrast to Nick this dog developed sexual erections *during* the period of difficult differentiation—not as with Nick, some years afterward (fig. 7b).

Under normal conditions, in the early part of Nick's stay in the laboratory, on the farm and after his return in 1941, Nick appeared to be active and not abnormal sexually. However in 1932 when in the paddock with Fritz and a female in estrus, Nick in contrast to Fritz showed a submissive attitude and no sexual activity. Instances have been mentioned, throughout his history, of normal and even apparently hyperactive coitus; as late as 1940, he exhibited sexual activity toward young male dogs, and in 1942 when over 12 years old he copulated vigorously with females in estrus.

The abnormal sexual erections elicited specifically by the environment of conflict came considerably later than the other pathological reactions. At first there were general definite changes in activity, extreme restlessness, inhibition of the food crs (as early as 1933); later appeared the stereotyped respiration, the pollakiuria (1935, 1936) and finally in 1937 the pathological sexual erections—first recorded on 20 May, 1937 to the sound of the metronome. At first infrequently, later the erections appeared oftener, not only when the dog was taken into the experimental camera and to the auditory stimuli used there but to isolated elements of this environment. Thus while on the farm in 1939 the presentation to Nick of the kind of food which had been used in the camera resulted more than once in immediate micturition on the food, and sometimes erection with ejaculation. Also the *social factors*—the presence of those who worked with him, particularly H.S. but also W.H.G., even in a remote environment as on the farm—repeatedly

evoked erections with ejaculation. It is remarkable to note that these reactions were elicited by close blood relations of the people who worked with Nick, the son and other close relatives of W.H.G., just as he had shown negativism to the brother of H.S. As the erections were never noted to any other people, there is a possibility that olfactory resemblances exist for the dog with members of the same family.

These pathological reactions instead of disappearing with time became firmly fixed and more frequent. However, they were never observed except when some element of the old environment was present. It would therefore seem that they were specific reactions. The only other time that such abnormal sexual erections were seen was, as noted in the history, during the specific pattern of whirling, scratching, and defecation when Nick was first taken off the leash; also in females under stress urination and defecation have occasionally been seen in the experimental room.

As pointed out earlier, the *pathological* sexual erections persisted with great obstinacy, while it was possible to produce artificially in the laboratory only very weak and fleeting normal sexual erections by the ordinary cr technique. This is in striking contrast to the ease of producing experimentally crs based on other URs, e.g., pain and food.

Parallels are to be found in both animals and human beings. Klüver (personal communication) found that the cebus monkey masturbates and practises fellatio when he cannot solve a problem, and C. F. Jacobsen (*91*) says his chimpanzees confronted with a difficult problem sit and masturbate.[12] Ischlondsky (*57*) has reported masturbation in school children during examinations and in solving laborious mathematical problems; Matte notes ejaculation in neurotic children. Whitehorn (*91*) saw a patient who began to have frequent and persistent erections when his sister married and who later got married himself to cure them but without success. W. Halsey Barker has told me of a nervous patient who had erections with ejaculation and subjective feelings of anxiety when he talked to his employer.

A patient of Dr. Victor Rosen's (anxiety) preceding his depression had erections with ejaculation when he walked in the part of the town near his home, where he had satisfied his homosexual drives. This patient previously had had unsatisfactory sexual relations with his wife who finally refused sexual intercourse with him. During his depression the patient experienced lack of libido and inability to have erections (cf. with Nick in camera). Cobb reports frequent sexual neuroses in patients suffering with anxiety (*91*).

[12] Klüver (*91*) believes the temporal lobes in monkeys have specific inhibitory centers for sexual activity as their removal results in masturbation and sexual hyperactivity.

note

For other instances see the discussion by Ischlondsky in the final chapter of this monograph.

From the above facts it is evident that in several dogs pathological sexual erections arise in the environment of conflict. Now we shall see what effect this environment has on normal sexual excitation produced by adequate sexual stimuli.

2) *Effect of the environment of conflict on normal sexual function.* After it became apparent that there existed a reciprocal relationship between the state of conflict and sexual excitation, experiments were performed to determine more exactly the effect of one upon the other. For this purpose we compared the effect of the camera, i.e., the working environment, on normal dogs (Billy, Pat) with Nick. The normal animals, although subjected to difficult differentiations in the camera, were stable animals who had never shown any permanent disturbances of behavior. Besides comparing the effect of this environment upon Nick and the normal dogs, experiments were done on Nick to determine the effect of the camera in contrast to that of the antecamera as well as to that of a neutral environment.

The sexual excitation (including erection, orgasm and ejaculation) was produced both by artificial means and by the presence of female dogs in estrus. Owing to the specific advantages of the artificially produced sexual excitation as a method of measurement, to be outlined in another paper, most of the data are drawn from such experiments.

Artificial sexual excitation can be evoked by peripheral stimulation (faradic) applied to the external genitalia for a given length of time. Such peripherally acting stimuli proved adequate for the initiation of marked sexual erections, accompanied by ejaculation of semen in most dogs. During the first experiment with Nick on 10 June, 1937, after 9 minutes of peripheral stimulation, 5 cc. of semen were ejaculated. In subsequent experiments with a constant period of stimulation (one minute) the items measured were the latent period of ejaculation, the time at which erection of the penis became complete, and its duration. The results are shown in Table 28 and fig. 43. From these it is evident that the camera had a much greater effect upon Nick than upon normal dogs. In Nick the latent period of ejaculation was markedly shortened (from 14 seconds to 6½ seconds),[13] the beginning of erection was slightly decreased and the complete duration of erection was greatly diminished (from 210 seconds to 73 seconds). In the two control dogs, the effect of the camera was in opposite directions, slightly excitatory in one, slightly inhibitory in the other, but in neither dog were the changes nearly so marked as in Nick.

Further evidence of the effect of the camera was seen in Nick after his rest in the

[13] Figures given are median values.

country. After the first removal to the farm for two months, on return to the laboratory the inhibitory influence of the camera was slightly less than formerly and after the longer rest of 18 months the camera had no inhibitory influence on the sexual reflexes (fig. 40).

TABLE 28

EFFECT OF ENVIRONMENT ON SEXUAL REFLEXES

Neurotic Dog—Nick

Outside Camera					Inside Camera				
			Erection					Erection	
Date	Interval (days)	Ejac. begins	Complete	Ends	Date	Interval (days)	Ejac. begins	Complete	Ends
1937 22 June	—	15"	30"	210"	20 June	7	10"		70"
2 July	3	17"	35"	165"					
6 July	4	10"	30"	220"	13 July	7	4"	20"	55"
20 July	7	10"	30"	180"	23 July	3	9"		85"
27 July	4	12"	45"	260"	29 July	2	6"		75"
Rest in country 1 August–3 October									
19 Oct.	6	25"	35"	205"	8 Oct.	6	7"	30"	120"
					13 Oct.	5	7"	25"	97"
Median		13"	33"	207"		4	8"	25"	80"
Percent change: Neutral environment		163%	131%	260%					
Neurotic environment									

Normal Dog—Pat

Outside Camera					Inside Camera				
			Erection					Erection	
Date	Interval (days)	Ejac. begins	Complete	Ends	Date	Interval (days)	Ejac. begins	Complete	Ends
8 Sept.	—	35"	40"	90"	10 Sept.	2	35"	40"	175"
14 Sept.	4	20"	35"	125"	16 Sept.	2	20"	30"	220"
18 Sept.	2	25"	20"	90"	21 Sept.	3	7"	40"	102"
Median		25"	35"	90"	Median		20"	40"	175"
Percent change: Neutral environment		125%	88%	51%					
Neurotic environment									

Normal Dog—Billy

Outside Camera					Inside Camera				
			Erection					Erection	
Date	Interval (days)	Ejac. begins	Complete	Ends	Date	Interval (days)	Ejac. begins	Complete	Ends
8 Sept.	—	6"	20"	120"	10 Sept.	2	7"	30"	130"
14 Sept.	4	6"	25"	250"	16 Sept.	2	8"	30"	120"
18 Sept.	2	7"	30"	225"	21 Sept.	3	4"	25"	150"
Median		6"	25"	225"	Median		7"	30"	130"
Percent change: Neutral environment		86%	83%	174%					
Neurotic environment									

The influence of the working environment and of the rest in the country on the sexual reflexes is parallel to the influence of the environment on the respiratory anomalies and on the cardiac rates (see fig. 10).

Although the number of observations on the effect of the environment on coitus are too few to warrant positive conclusions, in the beginning of 1941 it was seen that the duration of Nick's copulation with a given dog in estrus was somewhat delayed when the dogs were placed in the antecamera, i.e., when they were close to the environment of conflict, as compared with another floor of the building.

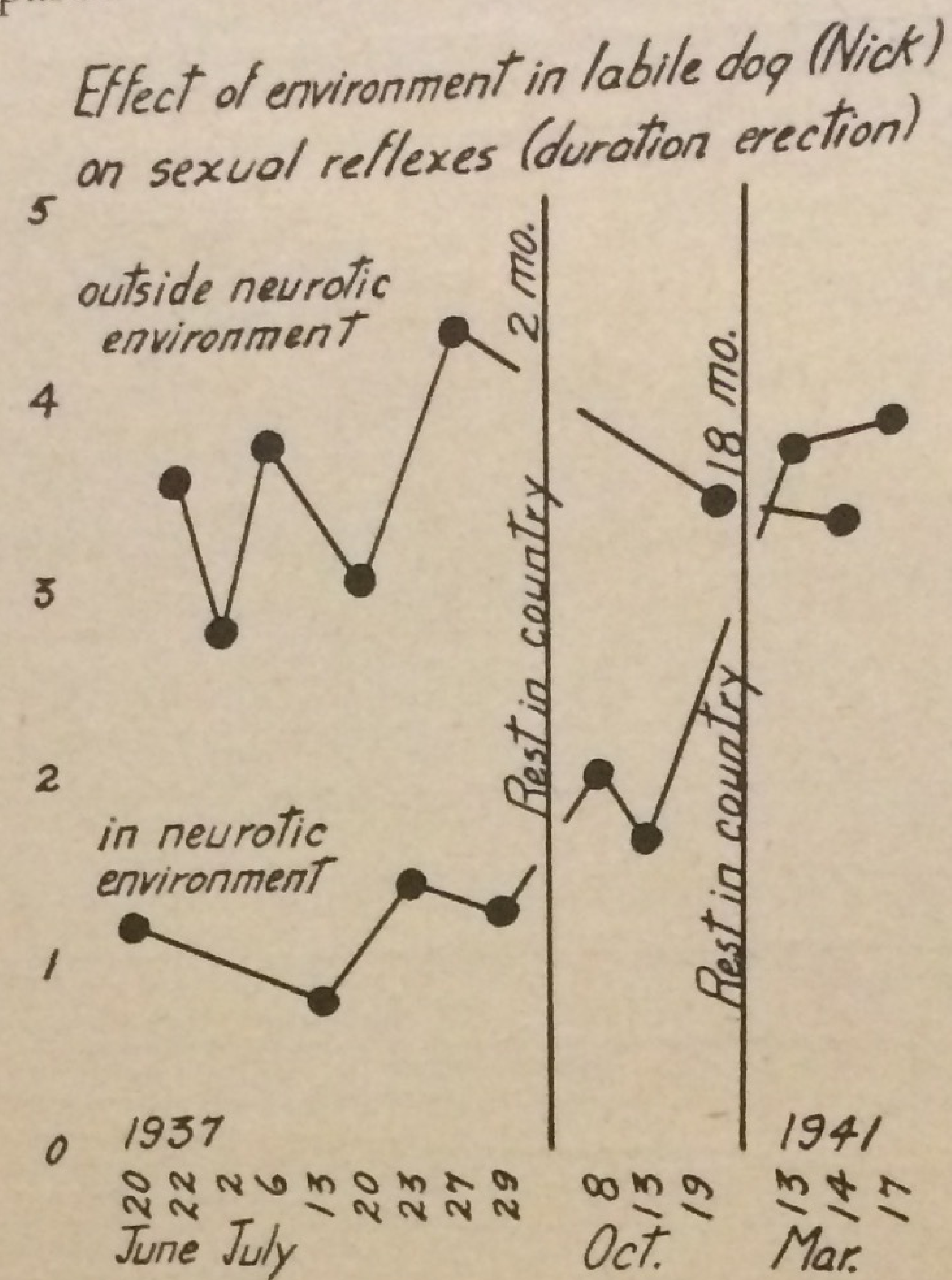


FIG. 40.

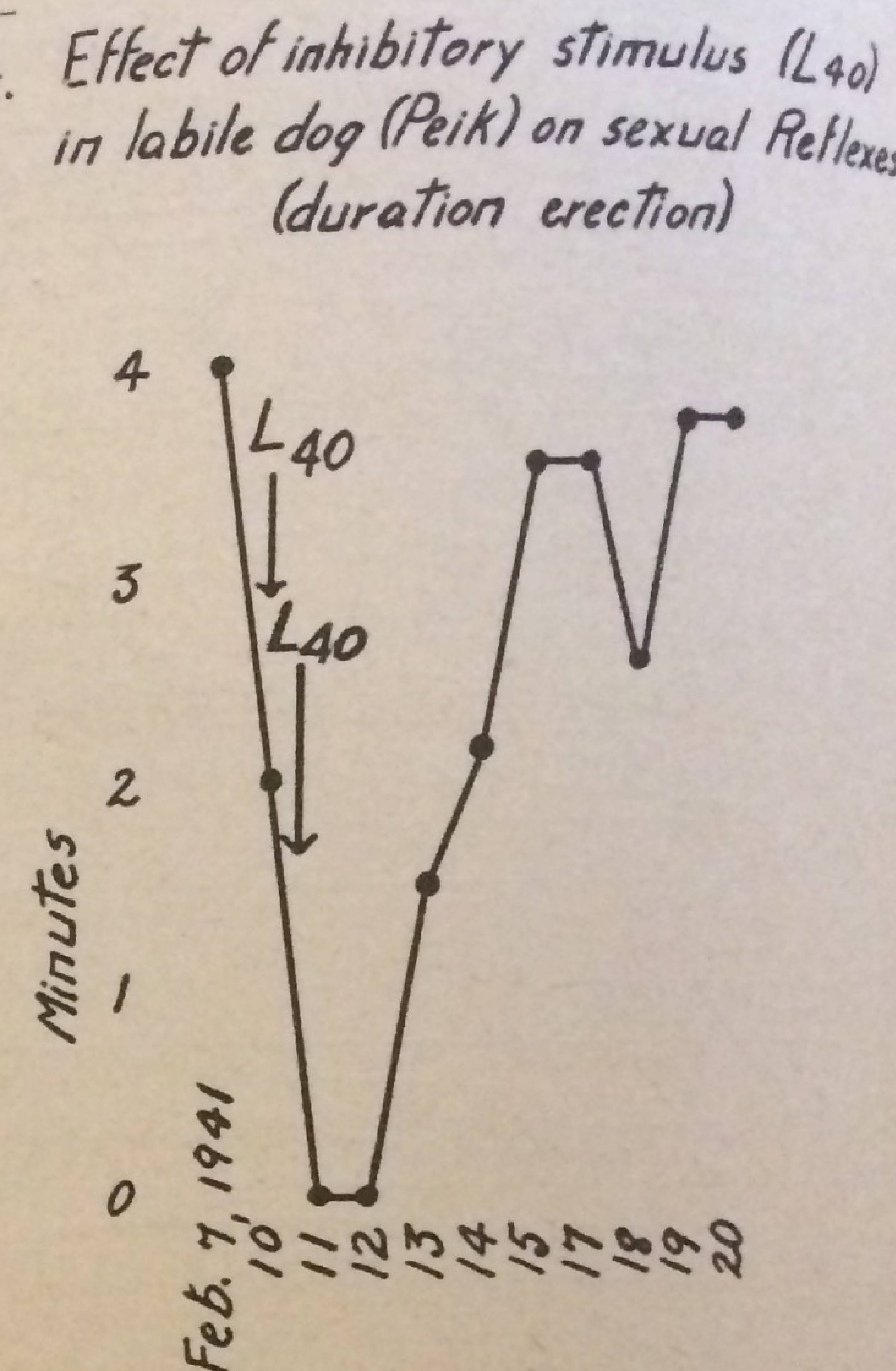


FIG. 41.

Peik was a dog who on casual observation appeared normal in the first year of work in the laboratory (1939), but who later seemed moderately labile. During this time he was subjected to the ordinary cr elaboration and differentiation. After he had been in the laboratory for 18 months and when subjected to the strain of introducing one more cs to those he had already been accustomed to, he began to show sexual erections, but on the contrary, the sexual reflexes to normal stimuli fell to zero.

Peik had been differentiating between M100 (+), and M80 (—). A new cs L60 (+) was introduced; after he failed to react to L60 the sexual reflexes to normal sexual stimulation disappeared as shown in fig. 41. When L60 was removed the sexual reflexes returned.

There was a disturbance in heart rates as follows:

Peik, 12 February, 1941. "Control heart rate = 90; during new disturbing cs = 66. The respiratory record also shows an inhibition of the respiration with L40 (the new cs).

The disturbance caused by L40 is shown not only in the inhibition of the cardiac and respiratory rates but in the inhibition of the sexual reflexes."

Peik was started in the laboratory in November 1939 with the formation of a cr to M120 and Bu. On 21 December Bu (+) was differentiated from M40 (—). Differentiation had been reached by 23 January, 1940. During this time the dog was quiet. Beginning in February 1940 sexual reflexes were measured. On 12 February, M100 (+) was given alternately with M40 (—); but differentiation was still poor by 23 March, although there was a good positive cr to Bu. Differentiation had been accomplished between M40 (—) and M100 (+) by 30 March after 229 repetitions of M40 (—) and 133 repetitions of M100 (+). This routine of Bu (+), M40 (—) and M100 (+) was repeated daily until 22 April, 1940 when the dog's metabolic rate was measured in the camera by fastening a respiratory mask over his snout; these measures continued until 3 June, when the routine of the three crs was resumed. In January 1941 Peik began to refuse food occasionally, though he remained quiet and maintained the differentiation. During this month M40 (—) was replaced by M60 (—) making the differentiation more difficult, and when this had been accomplished on 29 January M80 (—) replaced M60 (—). On 1 February this differentiation seemed to be accomplished, though the dog frequently appeared sleepy. On 5 February, 1941, differentiation was started between L100 (+) and L40 (—). Sexual reflexes were again measured on 7 February, 1941, and throughout February. By 19 February differentiation between the auditory stimuli was maintained but no positive cr had been formed to L40, and about this time the dog often refused food. From 26 February until 19 March metrazol convulsions were given, resulting in loss of differentiation between M100 (+) and M80 (—).

L40 (—) and L100 (+) were introduced on 5 February and used without the auditory stimuli until 14 February. With Peik the change of the routine from well differentiated auditory csi to a monotonous repetition of a new stimulus L40 (+), coincided with the loss of sexual reflexes, which gradually returned to normal when the different auditory stimuli were re-introduced, as shown in fig. 33.

Impotence, as well as abnormal sexual excitation is, according to Rennie, a frequent manifestation in various psychoses, especially in paranoia but also in schizophrenia (*103*).

3) *The effect of complete and natural sexual excitation on the neurotic* manifestations and on normal crs. Obversely, there was a reciprocal relation between sexual excitation accompanied by orgasm whether artificial or naturally produced, and the "anxiety-like" state. My attention was first called to this inhibition of the tension in 1936 when Nick was placed in a paddock with a dog in estrus. During this period, and for a week or more afterwards, we noted that Nick was much quieter when brought down into the camera, that the defense reactions were markedly diminished (whining, barking and restlessness), and that he ate much more readily in the antecamera than in the camera. These observations first led me to the detailed plan of experimentation on the reciprocal relations of sexual excitation and the neurotic manifestations.

The effect of the companionship of the dog in estrus on Nick proved to be much greater than our planned attempt to transform the environment by giving Nick all of his daily rations (meat) inside the camera for a period of 5 months, instead of the usual feeding in his paddock, away from the laboratory.

This effect was evident also in the reduced 24 hour activity.

Not only placing Nick in the same paddock with the female in estrus during the whole day altered his behavior in the camera, but sexual excitation either natural or artificial initiated in the camera, completely inhibited the "anxiety-like" behavior. Thus when a dog in estrus was brought into the camera, the tone which usually evoked definite reactions (whining, barking, restlessness, panting) was completely without effect. However, this dog had to be brought within one or two feet of Nick on the stand; then he began sniffing and paying attention to her instead of to the tone. That this was a specific effect is shown by 1) the necessity of proximity to Nick and 2) the following fact: this same dog brought down some time after the period of estrus had absolutely no influence, when placed in the camera with Nick, in preventing the "anxiety-like" behavior. Nor was it possible by the presence of any other dog, male or female not in estrus, to dissipate the neurotic behavior. As will be pointed out later, a person petting Nick, or sometimes even standing close to him had a similar though lesser effect than the dog in estrus on the neurotic behavior. (See respiration record, fig. 42.)

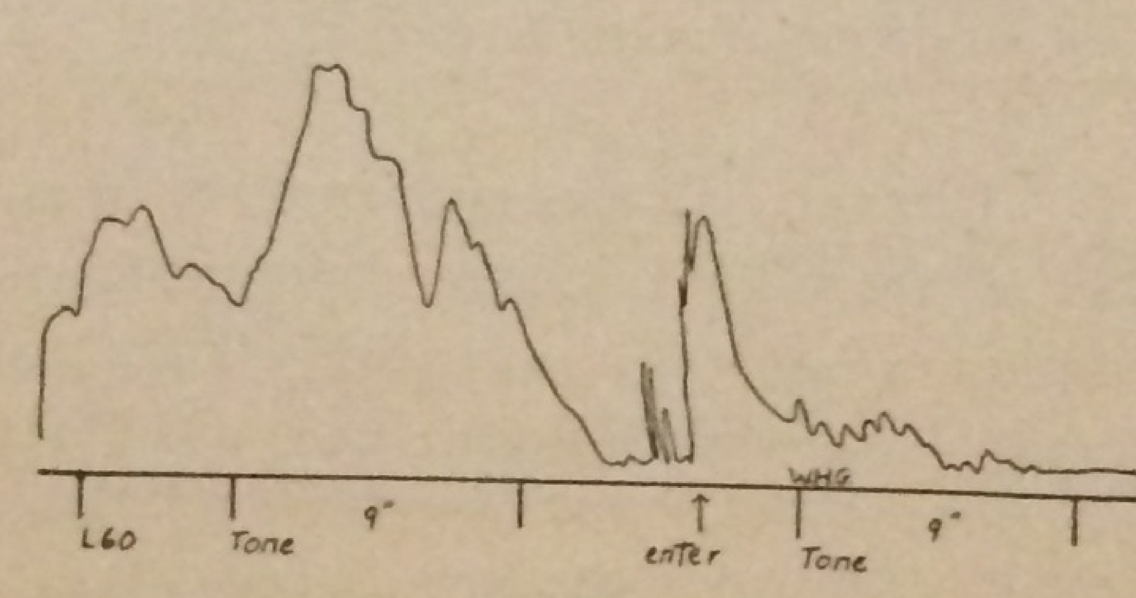


FIG. 42. Quieting effect of person in camera with Nick. Example of fourth type of respiration.

Sexual excitation produced artificially had the same effect upon the "anxiety-like" reactions, i.e., there was a long "refractory" period of some minutes after sexual stimulation when the anxiety producing csi were without effect, as described below. Moreover the effect of temporal distance from the sexual excitation could clearly be seen just as spatial distance from the tone was a factor in the intensity of his defense responses.

4) *Reciprocal time relations.* Several experiments were made which showed that artificially induced sexual excitation with orgasm had a definite inhibitory effect upon the anxiety state. One of these was as follows (10 June, 1937):

"13:45 Tone tried twice at two minute intervals; each time there are defensive movements, backing off, whining and a marked erection. On the first trial, the erection lasts about 30 seconds (T given for 20 seconds). On the second trial of T, the erection lasts about 75 seconds, the penis protrudes about 5 cm. beyond the prepuce. 14:00-14:09: peripheral sexual excitation produced marked erection (penis protruding about 12 cm.) with ejaculation 5 cc. semen; erection subsided

at 14:09. When T was tried during sexual stimulation at 14:05 it was without effect on Nick; no evidence of the defensive movements nor even of the orienting reflex—Nick paid absolutely no attention to it. Also when T was given at 14:10 there were no defensive movements whatever. 14:14: T given 20 seconds—no defensive movements but Nick orients by turning his head, but does not shift position. T at 14:22: defensive movements shown by backing off, but there is no whining and the defense is not as pronounced as before sexual stimulation. 14:49: T gives only weak defense reflex. 14:51: T (20 seconds) gives moderately strong defensive movements; Nick backs off, whining slightly; erection for 40 seconds." In each instance the tone was given for 20 seconds (fig. 43).

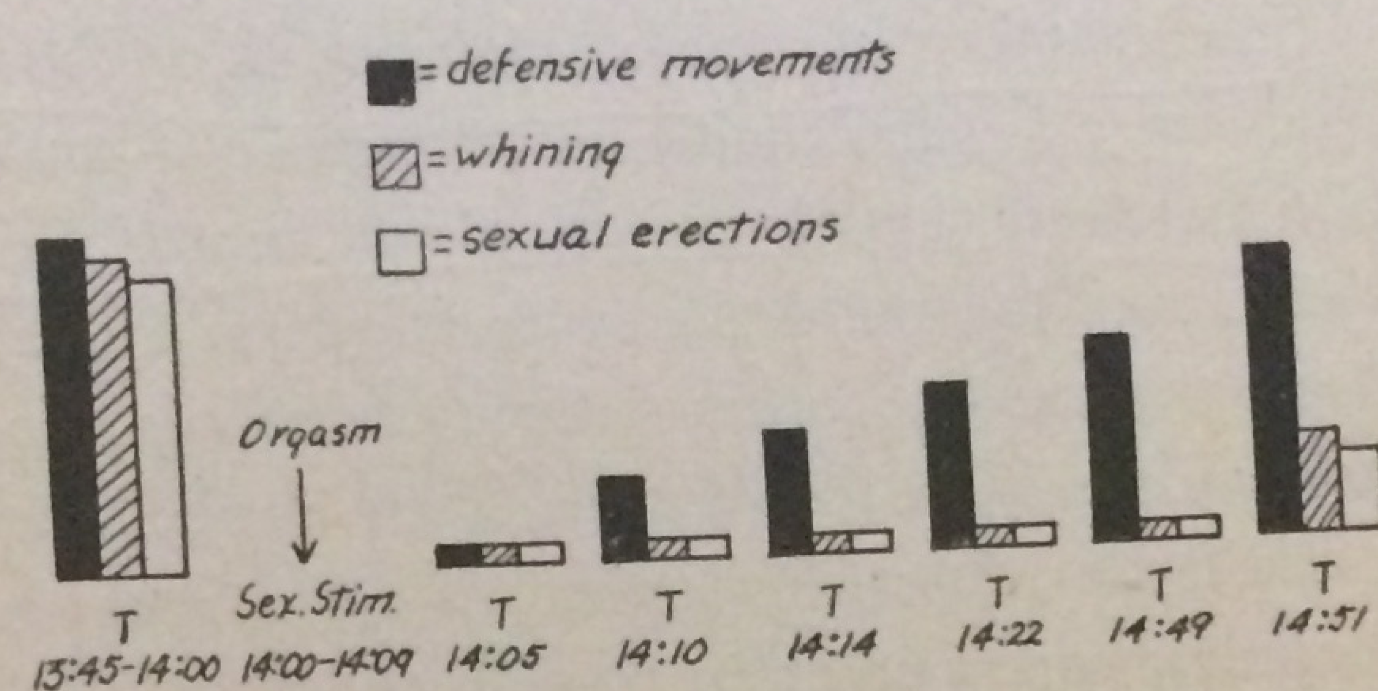


FIG. 43. Inhibitory effect of sexual stimulation with orgasm on anxiety reactions to tone (T) in Nick as manifested by defensive movements, whining and pathological sexual erections. Cf. with figs. 1, 7, 31, 32.

The above experiment offers striking evidence for both the effect of the tone in producing pathological sexual erections, and paradoxically of adequate sexual excitation in dissipating the pathological reactions to the tone. However it is clear that such artificially produced sexual excitation has only a limited temporary effect, and furthermore that this inhibiting after-effect lasts only a few minutes, disappearing gradually and not abruptly.

On 11 June, 1937, when sexual excitation was initiated at 15:30 o'clock by stimulation for 1 minute, a record of the respiration made at 16:10 is corroborative of the effects noted on the previous days—viz., that the obsessive defense reactions occurring to the tone given at 16:10, 16:11, 16:12 and 16:13 are not nearly so pronounced as usual.

Artificial sexual stimulation, used at intervals from 1937 to 1941, was never seen to have any effect on the dog's subsequent behavior other than the fleeting "refractory" period as noted above.

On comparing the intensity and duration of the after-inhibition (on defense reactions) from sexual and other forms of excitation (food, social, etc.), it is seen that *sexual excitation has by far the greatest influence*, next in order is the social, and finally the food, which has very little effect. This relationship can be more clearly seen in the acute "refractory" period than in the permanent effects; owing to complicating factors in the prolonged experiments the effect is difficult to evaluate.

Likewise there is in Nick an inhibitory after-effect ("irradiation") of sexual excitation on the food excitation; thus on 25 February, 1941, it was noted that

Nick would not take food during coitus, nor for some minutes afterward. This relationship, however, did not hold for the female with whom he was copulating, who accepted food even during coitus, nor does it hold for all male dogs. Thus, though in Nick it appears that the sexual excitation is much stronger than other excitations, or at least has the power of inhibiting other reactions, the same relationship does not necessarily exist for all dogs. It may indicate a sexual labileness in Nick comparable to his general autonomic labileness.

As noted in Chapter II and also in Chapter V (Nick 26 October, 1942) sexual excitation has a marked inhibitory effect on both the food crs and URs in normal male dogs besides Nick.

Since performing these experiments on Nick it has come to my attention that Maiorov (*80*) has made experiments confirmatory of ours on the reciprocal relation between sexual excitation and motor and salivary crs. He used a bitch in estrus, and he found the same effect on the crs of a male dog whether the male dog was simply together with the female in the camera or whether he was allowed to copulate with the female. Instead of showing complete inhibition of the crs as did Nick, Maiorov's dog exhibited various phases of hypnosis. Maiorov explains the inhibition as an effect of negative induction proceeding from the sexual centers to the cortical centers for the crs.

Examples of the strong inhibiting effect of sexual excitation on other physiological functions abound in Nature: such for example as the abstinence of the salmon from food in the breeding season. The glukharka (great grouse of Russia) is reputedly deaf while he is singing but only during the mating season; during his song then the hunter may walk boldly beneath the tree where he is sitting.

I have recently observed a clear cut instance of the acute inhibitory state produced by sexual excitation in the earthworm. Ordinarily when these animals are feeding they are very alert, withdrawing immediately into their holes in the soil at the slightest movement of the observer even when he is several yards away, reacting probably to certain vibrations through the ground, for they do not react to sound. However, when the worms are copulating, which they do by applying their inferior surfaces closely together for a distance of 3 or 4 cm., they give no response to an approaching observer though he may be standing within a few cm. of them, nor even to a slight tactile stimulus, especially if this is applied to the copulating end of the worm. The worm remains abnormally sluggish for one or two minutes after copulation is interrupted.[14] All these observations I noted repeatedly on different days in the spring months of 1938 and 1939.

Note

A long refractory state of the whole organism following sexual stimulation thus seems to be a general characteristic of the sexual function in many species. This

[14] W. Horsley Gantt: Experimentally Produced Sexual Neuroses. In press.

is perhaps the basis of the general postcoital suppression which has been observed: "omne animale post coitum triste."

The existence of a state of non-reactivity is not, however, peculiar to sexual excitation. I have shown previously that after each type of stimulation there is an inhibitory condition for that particular stimulus (See Ch. IV, section 5). Whether this condition is more like the refractory state of the peripheral nerve after excitation or is more similar to what Pavlov describes as negative induction cannot be decided by the present experiments.

Of interest here are the observations of Pavlov on both increasing as well as decreasing the sexual excitation in dogs. The former method (carried out by ligation of the seminal duct and simultaneous grafting of the gonad from a young animal) resulted in the disappearance of neurotic symptoms and the return of the conditioned reflexes to normal; this improvement lasted for 3 months (*89*, p. 57). Rioch and Bard note that the injection of estrogen (as well as the state of hunger) in decorticate cats raises the threshold for rage and fear (*91*).

Conversely, the weakening of the sexual reflexes through castration paves the way for a neurosis in animals of a certain type, viz., the strong type, but not in the well-balanced nor in the weak types. Pavlov's explanation is that castration weakens inhibition (already deficient in the strong excitatory type); in such castrated dogs he has obtained a state which he considers analogous to paranoia, in which the responses to only certain stimuli are abnormal. Both Pavlov's and Rioch and Bard's facts fit with the phenomena seen in Nick.

5) *Character of the sexual symptoms.* As pointed out in Chapter VIII (Constitution), variability of reactions, as well as stereotypy, is a pathological attribute. This was seen in the range of cardiac, respiratory and secretory responses. The same was observed in Nick concerning the sexual reflexes, which varied in duration from about 1 to 20 minutes, while in the normal dogs the variation was usually between 1½ and 3 minutes.

Alcohol also had a much more pronounced effect upon sexual reflexes in Nick than in any other dog (see figs. 48, 49).

The abnormal symptoms in Nick which apparently continued from day to day for a period of 6 years—restlessness, pollakiuria, erections and rapid breathing, pattern of defecation—are closely similar to what has been seen in stable dogs under normal sexual excitation. Thus on 26 October, 1942, other male dogs beside Nick in the same paddock with a female in estrus behaved almost identically as Nick does whenever he is brought into the experimental environment. This is an argument for the fact that Nick's neurotic symptoms bear a relationship to the manifestations of normal sexual excitation.

6) *Pathological sexual crs.* A large number of experiments were carried out in Nick and other dogs by the cr technic (a cs plus sexual excitation) in order to

produce artificial sexual crs. However this has proved very difficult, and only occasionally have definite sexual crs to a neutral stimulus been obtained. On the other hand, as seen above, sexual reflexes often occurred in susceptible animals as a result of a conflict, and thus it may be stated that sexual reflexes are readily conditioned as a component of the pathological process. This is somewhat comparable to other experiments from this laboratory, e.g., with adrenalin (*36*) illustrating the fact that it is easy to condition a change when the accompanying central state of excitation is set in motion, but almost impossible when a process to be conditioned is produced by a peripheral stimulation without central excitation. Thus salivary secretion can be conditioned to a food excitation but not to pilocarpine (Finch [*24*]); gastric secretion to food but not to histamine (*63*); hyperglycemia to emotional states but not to the injection of adrenalin (*36*). Although the production of sexual reflexes by peripheral stimulation undoubtedly has some central component, this is probably not so strong as the normal stimulation of a female in estrus.

Without laying too much stress on what may be only a superficial analogy I should like to point out the following striking similarities between the emotional states produced by sexual stimulation and by the stimulus of petting Nick (stroking him behind the ears). In both cases there is a definite and rather similar change in heart rate. Secondly the type of respiration during petting is almost identical with that during the final stage of coitus,[15] as shown previously (see figs. 34, 42). Thirdly each emotional state is followed by a "refractory" period of non-reactivity toward the anxiety-producing stimuli. (See figs. 12 and 43.) This period of non-reactivity is much longer with sexual excitation than with the social factor. With sexual excitation the refractory period lasts about 10 minutes and includes non-reactivity toward food, while with the social excitation it is only for some seconds.

It has been pointed out previously how much more intense and stable are the pathologic cardiac and sexual crs in this state of "anxiety" than they are to the natural, adequate situations, such as the real danger of another dog or adequate forms of sexual stimulation.

The predominance of the cardiac responses and the abnormal sexual expressions (erections, etc.) in the pathologic anxiety-like state of Nick and their persistence and greater stability in comparison with the normal cardiac and defense crs is parallel to the marked intensity of these reactions when they occur as components of a clinical pathologic state resulting from conflict.

[15] The character of the respiration changes during the various stages of sexual excitation; in the early stages it may be increased and irregular, but during the final stages, which may represent relaxation, the respiration becomes markedly quiet—deep, slow and regular—similar to what it is during petting.

7. Social Behavior

In spite of the dog's not standing so close in structural development to homo sapiens as do the apes, and the larger gap between man and the dog in the anatomy of the nervous system than between man and the apes, domestic animals in general and the dog in particular have special advantages for a study of psychopathology not possessed by other animals. These result from his most intimate relationships with the human and his role as the only willing slave to every caprice of his master. Of all the domesticated animals he is the one most generally accepted as a member of the human family. This advantage of the dog is seen in the laboratory when we consider that he willingly submits to experimentations necessitating his standing in one position as long as 8-10 hours, such as for example in the Pavlovian studies on secretion of pancreatic juice, and that he will even jump on the stand and remain quiet while his master inserts a needle into the vein to withdraw blood. In the dog we do not have to overcome a natural antipathy and suspicion toward the human being as we do in most other animals. Furthermore, although the dog possesses social traits and habits which are perhaps closer to those of the human than any other animal, he has not that marked investigatory interest, restlessness and independence of the primates and of man himself, which make the latter poor subjects for experimentation.[16]

Through his association with man lasting thousands of years, the dog has lost many of his lupine attributes and has adopted instead several of his human master, besides having made a nice sociological adjustment to living in the human family. The cat, the cow and the horse are oriented about their habitual home but it is the dog more than any other animal whose affections are directed predominently to the master, regardless of whence his food comes.[17]

From my own experience in the laboratory as well as from common experience,

[16] While forming crs on monkeys in Pavlov's laboratory in 1926 I observed a monkey who, having become conditioned to receiving grapes with the raising of a red flag, performed an experiment on the experimenter by reaching through the bars and raising the flag himself!

[17] An evidence of this came under my eye in 1934. An American Pit bull terrier was transferred to my farm after being in the laboratory for about a year. During this time I had made a salivary fistula in the animal and tested his salivary crs perhaps 10 days, but seldom seen him otherwise except for taking him home with me for one night. But he took a decided fancy to me: whenever I went to the farm he knew it almost immediately and would run 1/3 of a mile from the caretaker's house to meet me at my dwelling, follow me everywhere, sleep outside my door at night and not return to the caretaker's house even for food during the two or three days that I was there (though I had no food for him), and when I drove off he would trot, as fast as he could for several miles after the car. Many similar instances are known of how the dog will not eat after the bereavement of his master and may even grieve himself to death. It is perhaps significant, as we have shown in this laboratory, that the dog actually remembers with his heart, i.e., emotionally, much longer than with his muscles and secretions as measured by the crs and probably a longer part of his life than the human being.

there is evidence that the dog is more closely oriented toward his human companion than toward his canine fellows. Studies on the pathological animals confirm this view.

Owing to the strong natural social orientation of the dog about the human and particularly toward his master, he is an excellent animal in which to study the altered behavior arising from a disturbance in social relations.

With the above facts in mind regarding the dog's peculiar relationship to the master and the role of the human being in the dog's life, the observations of disturbance in these relationships as seen in Nick and other dogs appear highly significant.

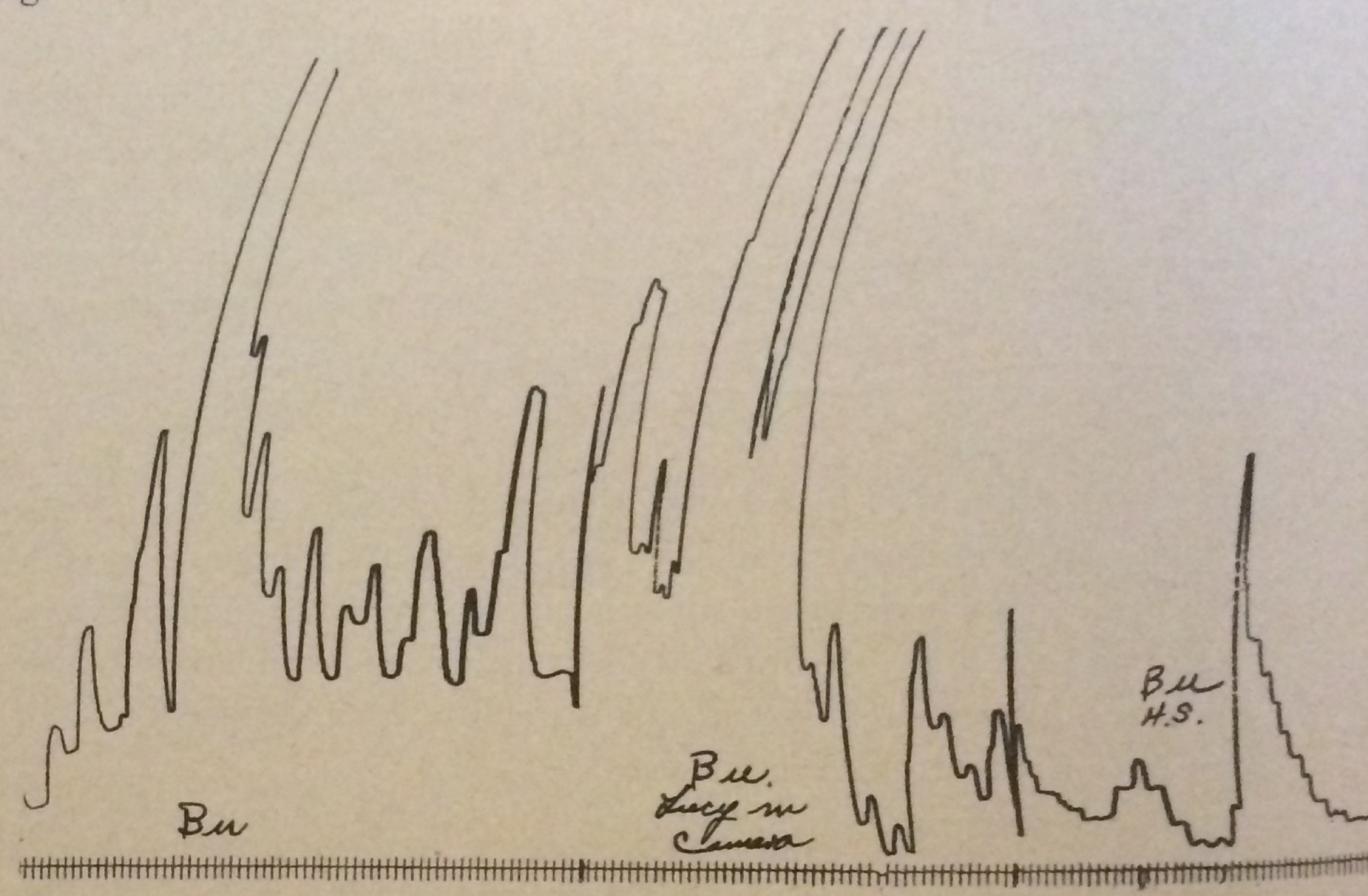


FIG. 44. Comparative effect of dog (Lucy) and of human (HS) on anxiety in Nick; HS abolishes anxiety reaction to Bu. (19 Jan. 1938.)

Certain pathological changes have also been seen in the relationship of disturbed dogs to the other canine members of the group. Among the causes of such disturbances are severe, prolonged fights among themselves, as have been pointed out in Billy and Kompa, Blue and Lady (Chapter III); the labile animals but not the stable showed marked changes in their behavior. Also in Nick the effect of females in estrus has been striking. I have pointed out under the discussion of sexual relations that the same dog (Lucy) when out of estrus had no effect upon Nick (see fig. 44). Another example of a canine relationship which may be a potent cause of disturbed behavior, measurable in the crs (shown by temporary loss of recent crs)

is that seen between the mother and her puppies, as was noted especially in Kompa and Omsk.

In contrast to these particular inter-canine stresses, is the evidence of a much greater susceptibility to the changes in relationship to the human being. These could be briefly described as 1) the eliciting of the anxiety reactions (including the asthma, tachycardia, pollakiuria, sexual erections, and even ejaculation) by the person involved in the experiment; 2) paradoxically the quieting effect of *any* human companion standing near Nick during the acute conflicts; 3) the permanent improvement resulting from human companionship.

Thus it has been seen in Nick that of all the dogs put into the camera with him, only females in estrus were able to dissipate the "anxiety"-like reactions to the situation, whereas any human being standing near him or petting him almost invariably inhibited the appearance of the anxiety symptoms, either completely or until the person left the room. This effect was so marked that even those people who worked with Nick and with whom he was ordinarily negativistic had the ability to dissipate his anxiety by petting him during the action of the pathological tone. Not only in his overt behavior was such an influence seen but also in the pathological effect as shown in the cardiac and respiratory records. That this was not simply a matter of external inhibition is proven by the fact that a person but not a dog dissipates the "anxiety," whereas if it were external inhibition any extraneous stimulus should dissipate it.

Conversely, by comparing the changes in respiration and heart rates caused by an aggressive growling bulldog brought close to Nick, a cat biting and clawing his back and the momentary appearance of H.S. through the window 6 feet away—it is seen that the human factor caused as great or greater change than these severe animal episodes.

Besides the human factor in both the amelioration and aggravation of the neurotic state, the behavior of Nick toward his canine and human companions is important.

Early in Nick's laboratory life he was seen to be submissive and retiring in a group of other dogs. Thus in April 1932, a note on the behavior of Fritz and Nick together in a paddock with a dog in estrus showed that Fritz was bold and aggressive while Nick sat in a corner by himself. At other times later during his life Nick exhibited marked aggressiveness (barking, bristling up) toward other dogs, but this was chiefly bluff as he rarely fought. Jealousy toward other animals was seen on the farm, but this too is a trait of normal dogs.

One of the early manifestations of pathological behavior seen in Nick was his peculiar fawning toward those who worked with him. He would turn over on his side close to the feet of such a person, or wrap himself around their feet, and then persist in slowly crawling up their legs, in spite of being pushed away. This type

of behavior has been noted throughout the life of Nick, directed particularly toward those closely associated with him in the experimental environment but not to the people outside of this environment, for example those on the farm and visitors to the laboratory.

Pavlov reported the same type of behavior in a dog after the changed procedure of the experiments had made him neurotic.[18]

Pavlov describes his dog as follows:

> Now we produce the neurosis. Until now the inhibitory stimuli had acted only for thirty seconds. In the following experiment we prolong it for an entire five minutes. On another day we repeat the five minute inhibition, and this was enough to change radically the whole dog, to make him acutely ill.
>
> Of the regularity of the conditional reflexes there remains not a trace. Each day showed a characteristic picture. All the positive conditional reflexes were markedly diminished, several completely disappeared. The inhibitory were disinhibited. Sometimes the ultraparadoxical phase set in, i.e., the positive stimulus was inactive and the inhibitory one differentiated from it gave a positive effect. During the experiment the dog was extremely excitable, sometimes breathing vigorously, very restless, sometimes showing marked excitatory weakness, reacting to the slightest fluctuation of the environment. Frequently he refused the customary feeding given after each positive conditional stimulus. In a word, concerning the work with conditional reflexes there was no doubt of an extreme, chaotic condition of the nervous activity. The same was manifest in the behavior of the animal. Putting the dog on the stand and preparing it for the experiment, and also removing it was not easy; for the animal was intolerant and uncontrollable. *When free he conducted himself very strangely; when lying on the floor he would turn on his side and crawl up to some one, which he never did before.* The *Diener* who took him to and from the kennel reported that he had become mad (89, p. 96).

This description applies closely to Nick. A marked and seemingly paradoxical characteristic of Nick toward those with whom he worked was his negativistic attitude. Whenever there was anyone else in the laboratory besides H.S. or W.H.G., he would immediately run to the stranger in preference to the others, and often he would not be induced by any means to approach either H.S. or W.H.G. The greatest antagonism was toward H.S., who was most closely associated in the experiment with Nick, and apparently next toward W.H.G. Very pronounced in Nick was this negativistic reaction toward other members of the families of the two collaborators who worked most closely with him. Negativism was not apparent toward other persons.

[18] It was not until the publication of this episode in 1941 that I knew of Pavlov's example. As the parallel between his dog and Nick was so striking I call attention to the independence of our observations to indicate that neither report was the result of suggestion—often an "unconscious" factor even in scientific observations.

The respiration reveals this ambivalent attitude of Nick toward his human mpanions. He often reacted to H.S. as he did to one of the conflicting stimuli igs. 30, 44). Here is seen the deep inspiration and the prolonged step-like ex-ration. But on the contrary a human being standing by and petting him had a arkedly quieting influence as shown by the slow smooth respiration (fig. 12). hus the same person could either elicit the anxious type of breathing, by simply ppearing before the dog, or dissipate it by petting him. The corresponding influ-nce on heart rate of a person has been referred to in a previous section (Table 25, g. 14). It is seen that the presence of W.H.G. although eliciting the anxious espiration inhibits the subsequent reaction of Nick to the tone.

A closely analogous instance was noted by Pavlov in 1924 in a dog whose crs ad vanished due to an emotional shock (flood). When Dr. Speransky, his master, at quietly in the room with the dog he began again to take the food. Even if an article of Speransky's clothing were placed in the room with the dog though not visible, the animal's reactions became normal (*88*). This example from Pavlov supports my observation that the effect of members of the same family may be dependent upon olfactory similarities.

A similar example is the quieting influence of a person being in the room with the dog during the early period of experimentation.

A most striking example of this negativistic attitude was seen the first day of Nick's arrival on the farm in 1937, when I met him at the station and walked him from there a mile to the house. Not only did he not exhibit any friendly feelings or even recognition of me, but he actively pulled away and tried to escape, hardly turning his head toward me during the whole walk.

However by kindly treatment and especially close companionship with Nick on the farm this negativistic attitude toward me was finally, after about a year, re-moved. He retained it toward H.S., however, to a milder degree when H.S. came to the farm, though he had never seen him before in that environment and had not seen him at all for over a year.

Since the normal dog runs avidly toward his master always in preference to strangers, whom he may or may not avoid, this negativistic attitude in Nick is the more remarkable.

Temporary negativism, lasting only several days, toward the master was seen in 1931 in other dogs as a result of the natural emotional shocks, as noted in Chap-ter III, particularly with Blue. This dog—a rather shy, vacillating type—slumped into a corner by himself and refused to walk with the experimenter after the pain-ful episode.

Besides the evidence of this negativism in the purposeful movements, it was expressed also on the autonomic level. Thus in the presence of the experimenters Nick showed marked increases in the respiratory and cardiac rates, pollakiuria, as

well as marked sexual erections and even ejaculation in the presence of certain people who had been associated in the experiments with him.

8. Generalization of the Neurotic Behavior

In the process of Generalization for both the normal and the neurotic animal the experimental milieu becomes a cs for the crs. This has been emphasized in the previous pages of Nick's history—how approaching the experimental camera or any element of it elicited the neurotic behavior. The effect of the camera can be seen in the heart rates, general behavior, etc.; figs. 45 and 46 show the readiness with which Nick accepts food on the farm in contrast to his behavior in the camera. Liddell has also found that sheep made neurotic to a certain room do not show the symptoms in another room (personal letter, March 1942).

It was possible in Nick to see a detailed and specific elaboration of neutral csi into pathological csi, as the following account shows:

Somewhat similar to the stage of generalization in the elaboration of crs is that of the neurotic behavior. During the period of formation of a cr to a certain signal, e.g., a metronome, the animal reacts to an undetermined

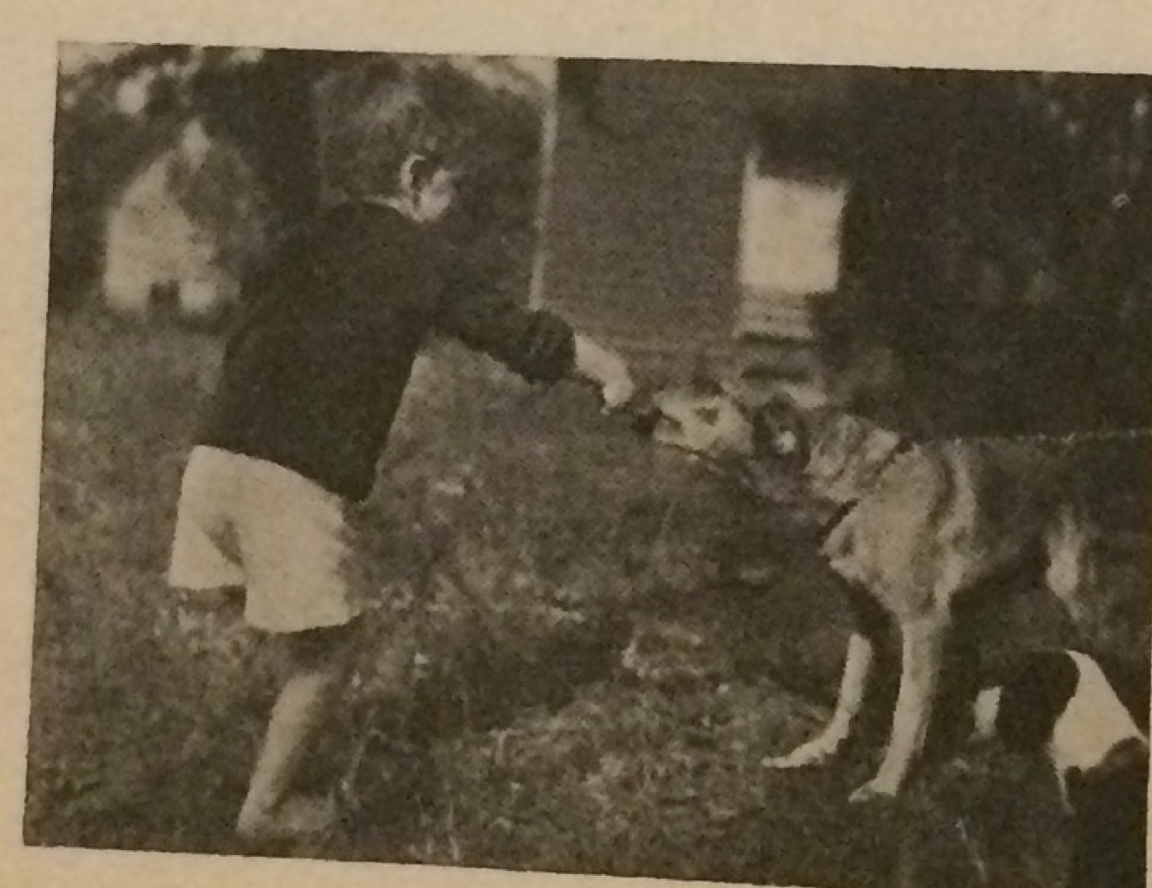


Fig. 45. Nick eating greedily on farm, 1940.

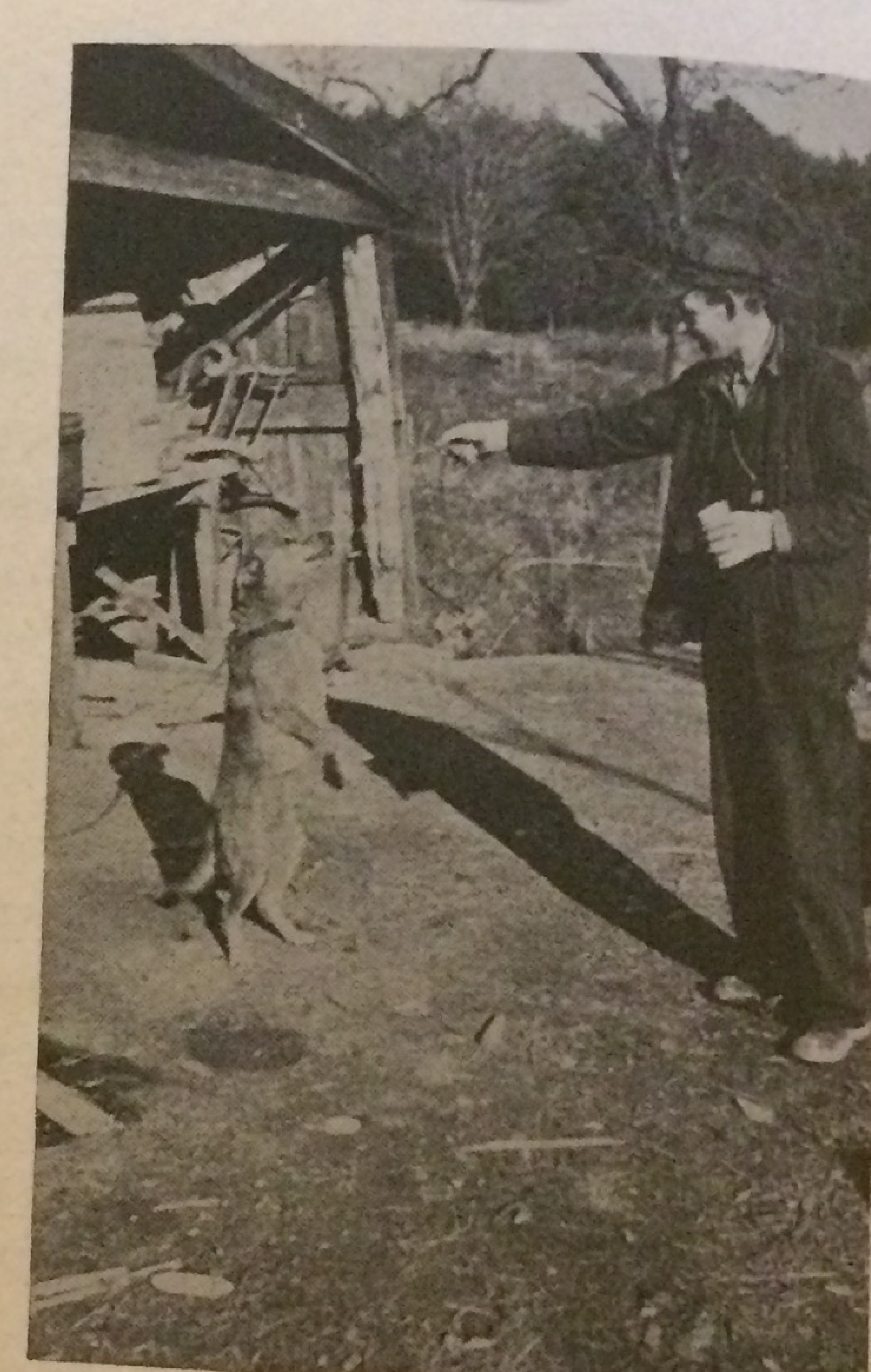


Fig. 46. Nick accepting food from attendant on farm, 1940.

range of similar auditory signals, thus metronomes of all frequencies, various clicks, etc. Only after a period of differentiation—reinforcement of one metronome by the US (food or shock) and failing to reinforce the other metronome—does the animal give a specific conditioned reaction. As a rule this state of generalization results in a cr only to stimuli closely related physically, e.g., all metronomes,

all tones, but the animal that is learning to react to a metronome does not necessarily react to a stimulus as different from the metronome as the tone.

With Nick, however, once the pathological disturbance became fixed to the tones, practically all auditory stimuli, though they had not been used previously with Nick, produced almost the identical pathological pattern as the tones. This was true for stimuli as far removed from the tone as air bubbling through water, metronomes, or a person whistling.

As these stimuli had never been given in the pathological environment, the dog's reactions to them may be considered as the result of a general lowering of threshold.

Another type of spreading of the disturbance could be seen—resulting from a repeated association between a new and neutral stimulus and any one of the above auditory signals. It was first noted that Nick began after several repetitions of my order to H.S., "All right Harry give the tone," to show the typical pattern of defense movements, etc., including retreating, whining, panting, erections.

After noting this it was planned to carry out the systematic elaboration of the pathological behavior to a more exact cs. Light being very dissimilar to sound and entering the nervous system through a separate analyzer, a light flashed 40 times per minute (L40) was selected as a secondary cs for the tone. In February 1938, L40 was repeated a number of times in the camera while Nick was on the stand, to determine whether it was neutral. Nick gave no response to it except for a slight orientation, i.e., a normal reaction. On 24 February, 1938, L40 was given for 15 seconds and after 5 seconds of stimulation by L40, a tone (1000 cycles) was given for 10 seconds. Thus L40 was made to precede T1000 by 5 seconds and then they were both given together for 10 seconds. An examination of the record for 24 February shows that on the 20th combination the pathological disturbance occurred to L40, 3 seconds after its beginning, and the same reaction to L40 recurred again on the 22nd and 23d trials.

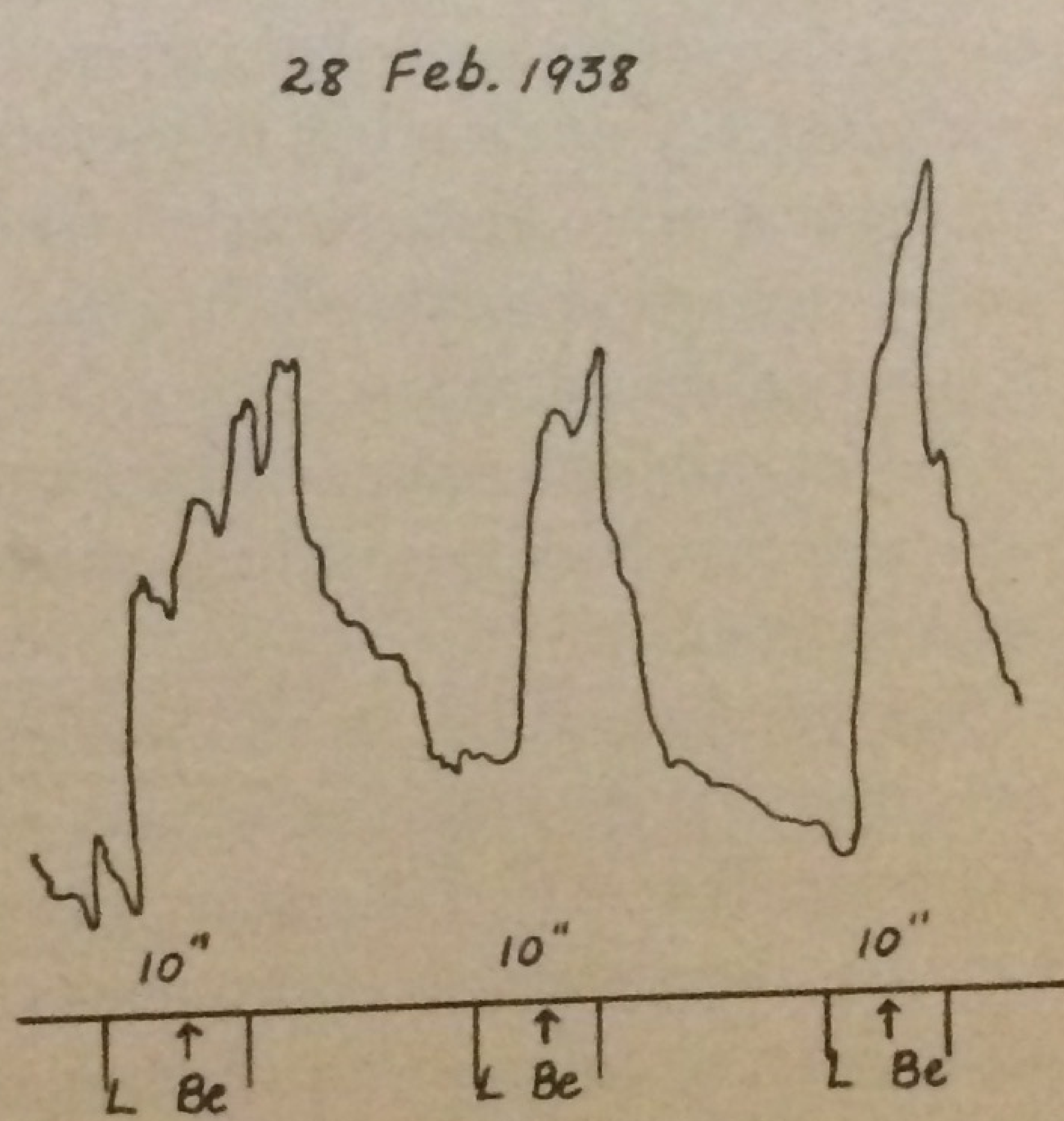


FIG. 47. Respiratory reaction of Nick to light and bell. Note respiratory crs begin several seconds after L.

On 28 February the pathological pattern which had appeared to L40 on 24 February had been lost. In order to restore it L40 was accompanied in the same way using, however, the bell instead of the tone. After 11 such combinations the dog began again to show the pathological reactions to L40—which he continued to do for the next 7 combinations (fig. 47).

That the acquired pathological behavior to L40 is weaker than to the auditory stimuli is shown on the 13th, 14th, 15th and 19th combinations of L40 with Be for that day where the pathological behavior to L40 but not to Be is irregular and completely dissipated by petting.

Nick was not experimented with again until 7 April, 1938. On this day L60 was used instead of L40 to see if generalization in the visual stimuli was present similar to the generalization seen among the auditory stimuli. It was found the pathological reactions to the light were retained for this period of 6 weeks, and that also generalization from L40 to L60 had occurred. An examination of the chart for this day shows that when L60 is used alone on the first 3 trials there is a decided reaction. From the 4th through the 11th trial L60 was combined with T1000; the reactions to the latter were more pronounced and more certain than to the light.

It is noteworthy that the pathological reaction to the light often has a longer latent period (usually 3 to 5 seconds) than to the auditory cs (less than 1 second) (fig. 9). This would indicate that L may simply serve as a signal for one of the pathological auditory stimuli. The question arises whether the light is simply a signal for the tone or whether it has itself acquired the same properties of the tone.[19] The former alternative is probably the correct one for the following reasons: the reaction to the light does not start at the beginning of the light as it does with the tone, but usually 3 to 5 seconds after the beginning of the light, and, when the light is given alone, the defense reactions are much more marked toward the end of the 5th second, which is the time when the tone usually is added. (See respiration record, fig. 9.)

No experiments were performed between 14 April and 6 May; on this day it was seen that Nick retained the pathological reactions to the light over this three week period.

L40 was next tried on 26 October, 1938; the only reaction then was a slight orienting one, showing that retention of the pathological responses had not lasted this long. But on 9 December, 1938, one combination of L60 and an auditory stimulus was sufficient to restore the pathological reactions to the light.

In comparing the speed of elaboration of the pathological reactions to a new stimulus (L), as well as the stabilization of such newly elaborated pathological responses and their retention, it is evident that the pathological pattern is much more quickly formed, requiring few trials, and much more stable in its appearance and longer retained than are the normal crs to either food or pain. The comparison is so striking as to leave no doubt concerning the ease of forming the pathological crs.

note

[19] The answer to this question might be given in normal animals by extinction of the auditory crs, but extinction of the pathological processes was not possible in Nick.

Another form of generalization, perhaps olfactory, was seen in the defense reactions of Nick to the close relatives of the two people (W.H.G., H.S.) who were most closely associated with Nick (Ch. V).

The mechanism by which these new pathological crs are elaborated may be compared to Pavlov's higher order crs, although the experimental procedure by which they were formed is somewhat different. In forming the higher order food crs the primary cs is given a few seconds subsequent to the neutral stimulus, and after a certain number of such combinations the neutral stimulus becomes a cs equivalent to the primary cs. In the experiments with Nick the neutral stimulus (light) preceded by 5 seconds and then overlapped the primary cs (bell, tone). With normal food crs, the neutral cs (light) should have become an inhibitory stimulus rather than a stimulus of the second order. Whether or not this difference is an inherent one for such a pathological pattern, or whether it is a special characteristic for Nick cannot be revealed by our data.

This is a somewhat similar situation to the normal one in which a neutral stimulus may be transformed into a cs. Lindberg and Volborth (*104*) have shown that when a neutral stimulus is given even in the *same milieu* with an inhibitory stimulus, the neutral stimulus acquires an inhibitory property though it does not coincide in time with another inhibitory cs; if it does coincide, however, its effect is stronger.

The speed of elaboration and the amazing stability of the new pathological patterns to the light in Nick illustrate clearly the mechanism by which abnormal reactions, such as phobias, anxiety states, etc., as well as prejudices, may be formed in the human being. Let any neutral stimulus, any perceptible change of the environment occur simultaneously with or even in the same milieu with an intense feeling, and this neutral stimulus will acquire the property of provoking the pathological pattern of reaction. Here the relation is even more accidental and less logical than the connection between cs and normal cr which must be based upon one or many combinations of the conditional signal and the inborn reflex action (UR). However in the pathologic state (Nick) a neutral signal coincided only a few times with one of the generalized csi of the pathological behavior. Such a neutral stimulus will itself evoke the same pathological pattern, in spite of the fact that this neutral stimulus has never occurred with the original excitant nor during the actual conflict, and may be removed even for several years.

The ease of formation of pathological crs compared with the normal may have a basis in the type of expression: the specific movement or secretion is the usual component recorded whereas in the pathological cr we are recording the emotional components. That these latter may be more readily conditioned and longer retained has some experimental foundation, e.g., it has been recently shown in this laboratory that the cardiac component of a food cr can be retained to last two years

when the more specific secretory component has completely disappeared (experiments of Marion Tunick). Also Muncie and I have demonstrated that senile patients with marked memory deficit lose the specific motor crs to painful csi but retain the emotional expression (reluctance to enter the room, rage, etc.)

Thus the basis for forming the pathological patterns and prejudices seem in the susceptible animal to be more active and potent than are the normal unconditional excitations such as food and pain. By such a mechanism it is clear how illogical and accidental are the relationships between some of the excitants, e.g., for the human anxiety states or for our prejudices, based as they are on certain emotional tensions. The combination of the neutral agent may, as is seen in the above experiment and is known to every clinical psychiatrist, have been so remote and accidental as to have been long forgotten. Apparent analogies are frequently risky. However the following human example is illustrative of how generalization may lead to unwarranted prejudices. A three year old normal child who was afraid of a certain man (without known reason) became frightened and started crying on seeing a picture in the newspaper of this man's cousin—not from the picture itself but only when told it was a cousin of the man who was feared. Such prejudices are illogical in the sense that they may have no connection whatever with reality external to the organism; but they may be strictly logical from another point of view—they may constitute the subjective superstructure to the reality that is going on *within* the organism, viz., the increased heart and respiratory rates as well as the other visceral components that have been demonstrated not only in emotions but as part and parcel of all the crs. (Gantt and Hoffmann [*42*], Gantt [*45, 46*], Whitehorn [*108*]).

In the beginning of this section it was stated that the environmental *milieu*, as well as a specific stimulus may become a powerful cs for the animal. Although it is the fashion to call the "whole" environment the stimulus this is not necessarily correct. The animal reacts to certain elements of the milieu and may neglect others. What the predominant stimuli are can be determined only by experimentation or observation—neither by guessing what we think is most important for the animal nor by assuming as we are often advised that the environment acts as an indivisible whole. On the other hand the organism fastens on certain of these elements and reacts to them; for example Nick giving sexual erections and ejaculation to the food used in the camera when this food was presented to him on the farm 200 miles from the laboratory environment, his sexual erections to the people who worked with him, his reacting to whistling and other similar auditory stimuli the same as he did to the tones.

In my article "The Role of the Isolated Conditioned Stimulus in the Integrated Response Pattern, and the Relation of Pattern Changes to Psychopathology" (*41*) I have attempted to point out why it is even more fallacious to speak of the "whole

environment" than of only a single concrete cs as the main stimulus for the organism. In leaning over backwards to avoid one pitfall the proponent of the "whole" often somersaults into the opposite pitfall, showing the danger of verbal generalizations without studying the facts in any given situation. The careful investigator will not be satisfied with the phrase the "whole environment" but will look for the parts of the environment that are essential to the organism.

9. CLINICAL CORRELATIONS

Although it is not possible to diagnose Nick according to a clinical disease-entity—if such exists in psychiatry—it is interesting to point out the analogy of the objective symptoms. To do more than this at the present time is a thankless and unprofitable task owing to the unsatisfactory basis of the present clinical classification. The unstable basis for classifying psychiatric conditions is shown by the fact that often psychiatrists disagree in a large percent of diagnoses, or that the diagnosis is changed during the course of the illness. For example the prolonged dispute among eminent psychiatrists as to whether the depressive reactions occurring at middle age form a separate group (involutional melancholia) or should be considered as manic depressive; the classification of anxiety states as merergasias has been questioned recently by Leslie Hohman (*56*) who produces evidence that they are more properly milder degrees of pathological depression and elation. Palpitation, choking attempts to escape, and fearful-like timidity of the anxiety state might be applied to Nick's behavior. But since in the patient the emphasis is on subjective symptoms and in the dog necessarily on the objective, a close comparison becomes difficult.

Owing to the above considerations as well as to the wide variations from patient to patient, the thorough study of the individual and his particular reactions to life situations, i.e., the patterns of behavior and their origin is probably much more significant than the attempt to place him in a group of disease-entities.

A further obstacle to comparing the animal with the human patient rests upon a difference in methods of examination. In the dog the only phenomena that can be objectively recorded and measured impress themselves upon us by certain physiological observations plus the gross changes in behavior. In the patient the diagnosis is chiefly, though not altogether, made on the basis of the patient's subjective reports of what and how he feels, the sensory impressions as hallucinations, etc., *plus* his ability to maintain a satisfactory rapport with his work and in his special society. The data of clinical psychiatry are obtained almost exclusively through the medium of speech, while in the animal this is the one method by which we obtain nothing.

In spite of these differences, certain resemblances seem warranted. The chronic, stereotyped patterns of reaction in Nick are mainly evident in particular environ-

ments or occur to elements of this environment. Although measurements of his 24 hour activity indicate that the effect of the environment may extend far beyond the period that the animal is actually there, the striking pathology is strictly environmentally determined. Further proof of this is the benefit when removed from the environment, and conversely the possibility of forming new pathological stimuli in the given environment.

The stereotyped pattern of Nick's behavior and certain adventitious actions were as prominent as any seen in patients. Besides those disturbing reactions connected with the conflict of the camera was the playful attitude toward the food used in the experiments (Spratts ovals) outside the camera—picking them up, fumbling them, or running around the room with them in his mouth, then dropping them, and rolling them on the floor with his paws. Another marked symptom was his extreme hyperactivity especially in the experimental environment, his stereotyped jumping off and on the stand in the camera.[20] Negativism toward the people who worked with him continued for years.

Such negativism, a prominent symptom in Nick, has been reported in many of Pavlov's dogs. Thus in his animals during the hypnotic phase, the dog stubbornly turns away from the food but attempts to get it as we remove it.[21]

The stereotypy, playfulness, incontinence and negativism are prominent symptoms of schizophrenia, but the fact that these phenomena in Nick were confined to the environment or its elements of the conflict and that his total behavior was not predominantly disturbed were objections to considering him a schizophrenic.

Very prominent and persistent among the abnormal symptoms was the orientation of Nick toward the former location of the pathological tone, and not toward the new position given it about 1935—after the period of acute stress. This orientation consisted in turning his body, gazing at a spot and backing away from it (see frontispiece and fig. 39). The failure of Nick to react to reality in the present, but to a pathological stimulus of the past is a constant and immutable symptom which has lasted for over 7 years, and appeared with clock-like regularity. This orientation to the past is in fact no more significant than the spontaneous transformation of Nick's food crs to defense reactions, but it is more striking, in-

Note

[20] Pavlov has observed in his disturbed animals symptoms of stereotypy, e.g., constantly repeated prolonged licking of certain objects. Many other movements may become stereotyped in the pathological animal. (*89*, pp. 40-41).

[21] Pavlov, though usually remaining objective, contrary to his principles indulged in the following subjective explanation: "One can conceive in all likelihood that, if these dogs which have become ill could look back and tell what they had experienced on that occasion, they would not add a single thing to that which one would conjecture about their condition. All would declare that on every one of the occasions mentioned they were put through a difficult test, a hard situation. Some would report that they felt frequently unable to refrain from doing that which was forbidden and then they felt punished for doing it in one way or another, while others would say that they were totally, or just passively, unable to do what they usually had to do" (*89*, p. 84).

volving as it does vigorous and stereotyped movements away from a specific place in the camera.

Pavlov considered such an action an obsession. He describes a dog in whom a similar perverse reaction persisted 18 months after the stimulus had been replaced by one in another position—but in Nick the same pathological reaction persisted for 7 years. Pavlov says: "Other conditioned stimuli were located in various other places, but when they were put into action the dog still preferred to turn towards the place where the noise had been produced. . . . On the application of any other stimulus originating in quite a different place the movement of the dog was always directed to the place where the noise had formerly been heard. . . . Towards the end of the interval between the conditional stimuli, i.e., before the beginning of the next stimulus, dogs often get into a state of "food excitation" (time reflex), either turning towards the food-box, or to the place of one or the other conditioned stimulus. The above-described animal turns only towards the place from which, long before, the noise had been heard" (*89*).

This description of Pavlov's animal could be applied almost verbatim to Nick.[22]

Another action of Nick's suggestive of compulsive behavior was the stereotyped way in which after the neurosis he picked up the food, ran about the room with it, fumbled it, rolled it on the floor and played with it, though he would not eat it.

Most of the other symptoms were expressions of pathological functioning of the autonomic nervous system—in the respiratory, cardiac, gastro-intestinal, urinary, and sexual systems.

The striking and stereotyped manner in which these various symptoms appeared over a period of 8 years in Nick, and the apparent lack of marked interference with his life outside the laboratory would place him in the category of those patients showing patterns of dysfunction in the autonomic nervous system such as characterize the anxiety states,[23] though it is true the extreme hyperactivity and playfulness in the environment are symptoms seen in the manic.

Stanley Cobb,[24] in summarizing the symptoms of 100 patients with what he prefers to call anxiety attacks rather than neuroses, lists the following manifestations and their frequency: *palpitation* 96%; *attacks in a special setting*; *fear* 90%; *sexual* difficulties 88%; *dyspnea* (smothering) 85%; *trembling* 75%; *sweating*; headache 98%; irritability 90%; chest oppression 70%; dizzy, chills, pain 60%; fainting 25%. These symptoms he states also characterize neurocirculatory asthenia in the Army. There is a striking parallel between the objective signs in Cobb's

[22] Although Pavlov's observation was made in 1934, before mine, I was not aware of it until I translated his book, "Conditioned Reflexes and Psychiatry," in 1940.

[23] For an excellent discussion of the prominent symptoms of anxiety, their etiology and the objective manifestations see Greenacre (*51*).

[24] Report read at the Association for Research in Psychoanalysis and Experimental Psychodynamics, 21 December, 1942.

patients (italics above) and those of Nick; since the other symptoms depend upon the report of the patient no comparison can be drawn. Every somatic manifestation of Cobb's series is a marked symptom in Nick.

Furthermore the respiratory changes in Cobb's patients bear a close resemblance to those of Nick. Cobb noted respiratory anomalies that are closely comparable to the 1st (rapid panting) and 4th types (quiet, after petting and sexual excitation) of respiration in Nick, and another kind in patients having qualities of the 2nd and 3rd types in Nick. The very rapid breathing of Cobb's patients during Army inspection or when they thought of something unpleasant was similar to the panting of Nick, and the slow regular breathing of a patient when he recalled a fishing trip and vacation (even slower than his relaxed breathing) was almost exactly similar to that of Nick when he was being fed or during the last stage of sexual stimulation.

The impotence and sexual difficulties described by Cobb also find a parallel in the suppression of the sexual reflexes in Nick in the environment of conflict. The sinus arrhythmia, present in 96% of Cobb's patients, was a striking symptom from the very beginning of Nick's disturbance, not only to the environment but to all its elements and even to the people connected with it. Moreover the heart rate varied in Nick according to the person who was taking it, an observation which would be interesting to confirm in patients.

If Nick had been a patient he would undoubtedly have been treated for anxiety attacks and been labelled with the terms merergasia, phobias, gastric neurosis, functional tachycardia, asthma, enuresis, ejaculatio praecox, etc.

VII. SOME FACTORS IN THERAPY

OWING TO THE FACT that in clinical psychiatry, drugs, except for the possible value of those used in shock therapy, have had only an ameliorative effect, and that the use of such sedatives as bromides has been thoroughly studied by Pavlov, Dworkin and others, a thorough study of the pharmacological treatment of the experimental neuroses has not been carried out here.

Pavlov showed that bromides had a beneficial effect on the experimental neuroses only in dogs of a certain type, and that the dose should be accurately regulated in accordance with the type—for the strong type 5 to 8 times greater than for the weak type. Its effect is the reinforcing of the inhibitory function particularly in strong and unbalanced types (*89*).

Dworkin has confirmed Pavlov's findings with bromides in dogs. However he finds that even hyperactive cats do not respond to bromides favorably, and he concludes that this drug must be carefully selected in reference to both the species and the type of neurosis. (Personal communication of unpublished data).

Certain forms of therapy however warrant attention here. As cortin had been reported of value in anxiety states (Thorn [*54*]) and as Liddell (*71*) had found that it diminished motor hyperactivity in the sheep, this drug was given to Nick for several weeks in 1934, however, without benefit, as mentioned in Nick's history.

Alan Gregg (personal communication) has suggested that alcohol might relieve tensions[1] in the experimental neuroses. Experiments in several dogs indicate that it has certain temporary effects in this direction, which do not continue however more than some days (rarely longer) after the administration, i.e., the relief is not permanent. In one of our dogs, Blue, who was a shy, sensitive, somewhat inhibited type, the use of alcohol on several occasions made him more normal the next day in his relation to other dogs, with the result that he defended himself against the aggression instead of running away.

Alcohol was given to Nick in May, June and July, 1938, and also in April, May and June, 1939, chiefly for the study of the effect upon the sexual reflexes. As in other dogs, alcohol had a delayed effect on the onset of ejaculation and a shortening of the period of erection in small doses (1 cc./kgm.) and in larger doses (2 cc./kgm.) completely inhibited the appearance of the sexual reflexes. With 1 cc./kgm. alcohol the latent period of the onset of erection increased from 30″

[1] H. G. Wolff has recently shown that alcohol has a marked analgesic effect on physical pain. It changes markedly the mood, and from previous work it is known that it lessens tension between excitation and inhibition by impairing differentiation.

(control) to 35″ (alcohol) and the duration of erection decreased from 11½ minutes (control) to 6.7 minutes (alcohol). Since the camera itself had a tendency in Nick to produce ejaculatio praecox, the use of small doses of alcohol may be said to correct this, though at the same time diminishing by one half the duration of erection. However, the high control figures, taken on alternate days to the alcohol, which was given two or three times a week, apparently resulted from the use of alcohol on the previous day, as they were never so high before as during the period of alcohol administration. This remarkable and unusual effect obtained in Nick on the days following alcohol administration showed that the sexual erections to adequate stimuli were increased from the normal average of about 3 minutes to an average of about 12 minutes after a single large dose of alcohol on 17 May, 1938. This effect lasted until 22 June, 1938, as shown in fig. 48.

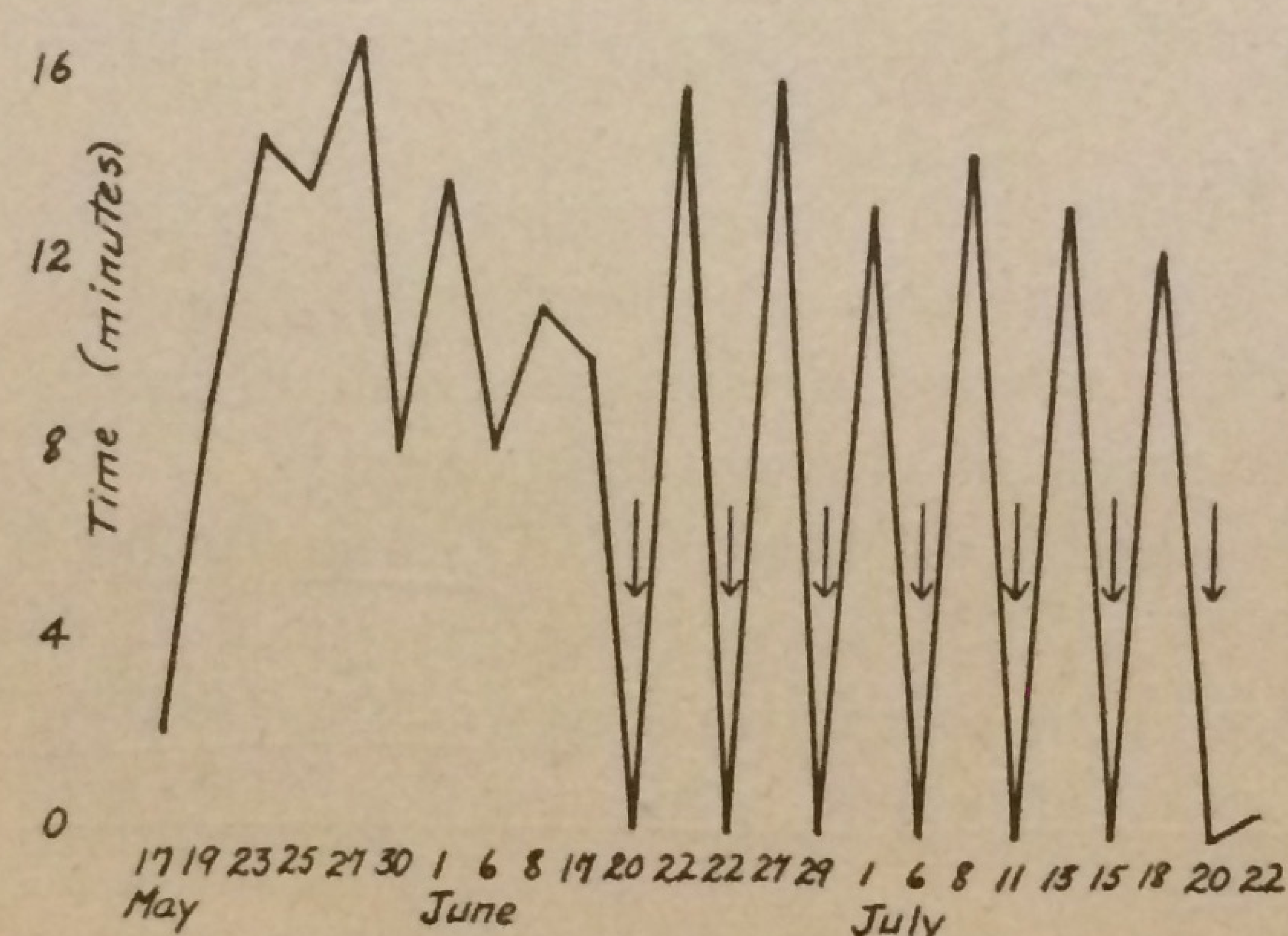


FIG. 48. Effect of alcohol on duration of sexual erection in Nick. Administration of alcohol indicated by arrows.

The alcohol not only completely removed the inhibitory effect of the camera on the sexual reflexes but resulted in their being much larger even in this location than they ever were elsewhere. It was also noted that Nick was very much quieter in the camera after this dose of alcohol (2 cc./kgm.). The tone or bell continued to have a slight inhibitory effect on the sexual erections. The large dose (2 cc./kgm.) was repeated on 20 June, 1938, and though the sexual reflexes were completely abolished on that day, they showed a new peak on 22 June inside the camera and even in the presence of the tone. Fig. 49 shows how the sexual reflexes continued strong for the next few months.

Beginning on 29 March, 1939, small doses of alcohol were used and on the alternate days sexual reflexes were again markedly increased.

With yet smaller doses of alcohol on Nick (0.5 cc./kgm.) there was very little effect on the sexual reflexes.

The effect of alcohol on the sexual reflexes in a series of normal dogs is as follows: with small doses (½ cc./kgm.) there was only slight change but with moderate doses (1 cc./kgm.) the latent period was prolonged somewhat and the duration of erection markedly shortened. With large doses (2 cc./kgm.) the sexual reflexes to adequate stimuli were completely abolished. The alcohol was given in a 20% solution orally on an empty stomach. Even with small doses the alcohol did not have any stimulating influence (fig. 49), the *increase* of latent period of

both ejaculation and erection and the *decrease* of the duration of erection representing diminished tension of sexual excitation.[2]

Shock therapy has not been tried on Nick because of the dangers involved and because of the interruption which would result to the other procedures already planned for him. Metrazol, however, has been studied by Rosen and Gantt (97) for its effect upon the behavior of normal dogs.

Four adult dogs were used in whom crude and differential conditioned responses were induced during a controlled training period. In two of the animals the salivary reflexes were used and in the other two motor defense reflexes were studied. After this period a series of ten metrazol convulsions were induced on alternate days with testing of the conditioned reflexes on the interval day. They were also followed for a period of several months after the cessation of the convulsions.

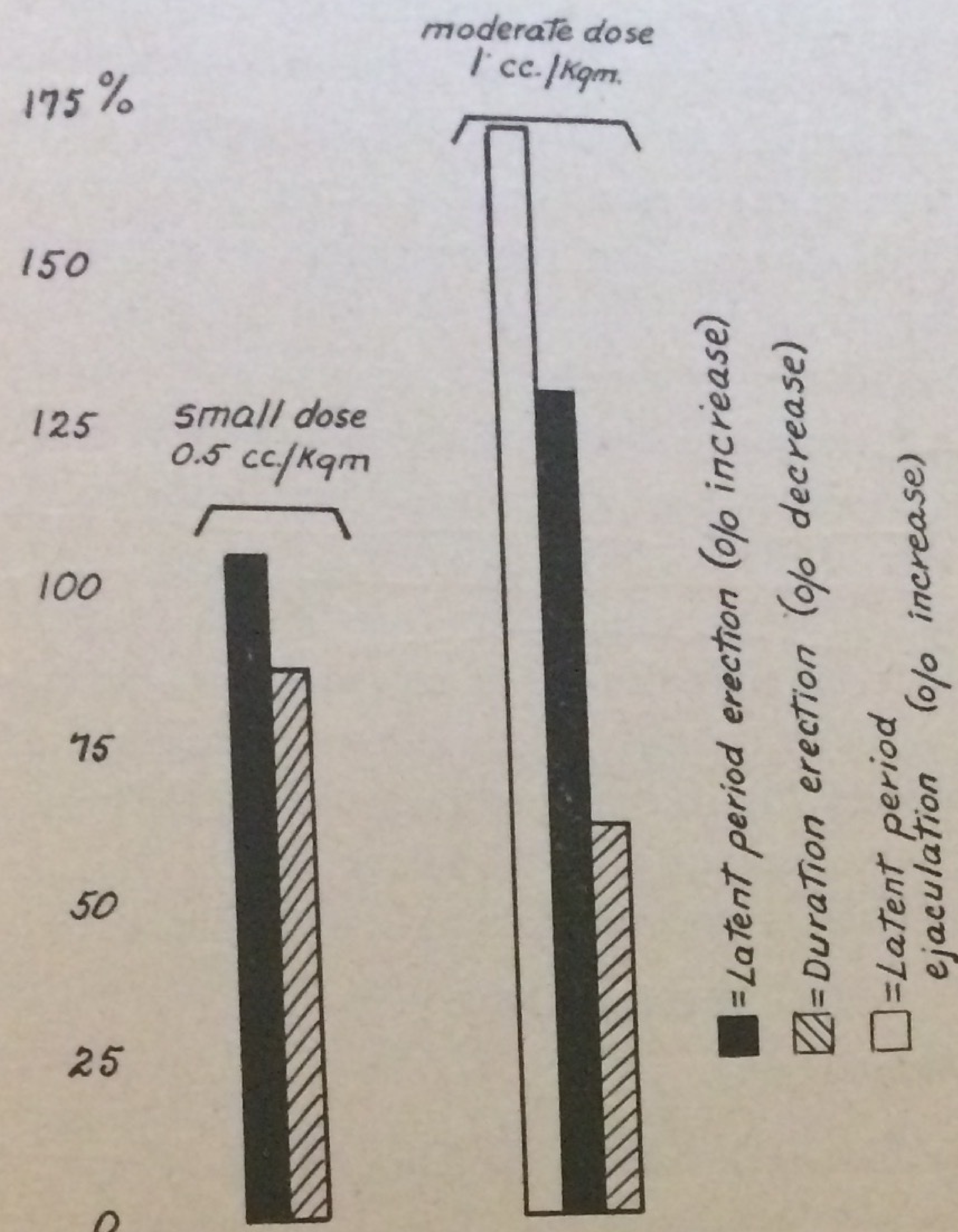


FIG. 49. Effect of small and moderate doses alcohol on sexual reflexes expressed as percent change of normal as 100%. Note decrease of duration of erection and longer latent period.

The convulsions appear to disturb the differentiating ability of the dog affecting the inhibitory responses temporarily more than the excitatory ones. They have a greater effect on the autonomic salivary reflexes than on the motor defense reactions. It also appears that the overt changes in behavior observed depended upon the original temperament of the animal; there is an apparent improvement in the performance of the "excitatory" animal and a decrease in the efficiency of the performance of the "stable" animal. Furthermore there was a tendency for the dif-

[2] It is not to be denied that this effect of alcohol might be in the direction of therapy in patients in whom tension is too great or the latent period of ejaculation too short as seen in the ejaculatio praecox of many anxiety patients. Thus the use of alcohol in Nick may be considered to have an immediate therapeutic value, though as all clinicians will recognize there are many indirect social factors to be considered. As will be pointed out in another paper, benzedrine may have a better effect here than alcohol (fig. 202.).

ferentiating ability to return slowly following the cessation of the convulsions (figs. 3a and 3b).

Persistent efforts were made to transform Nick's attitude towards the experimental environment by influencing this through the change of tension in the food excitation. As starvation for 48 instead of 24 hours stimulated him to enter the camera more readily and lessened the defense reactions somewhat, an attempt was made to transform the experimental environment from a painful to a pleasant one by giving him his daily ration of meat there and only there for several months in 1936. Except for the fact that he did accept his food in the camera and he seemed a little quieter during these months, no permanent effect was obtained.

Another later procedure which gives more therapeutic promise is the connection of the csi (originally associated with food and later evoking conflict) with a new UR excitation (drive). In March 1942, as described in his history, an attempt to form out of the old csi new ones for a definite motor defense reflex, has resulted in Nick's not only being able to form these new motor crs out of the old csi for anxiety, but in a marked reduction of the restlessness and agitation. A comparison of the respiration on 18 March, 1942, (fig. 50), with that of a year ago (figs. 25 and 26) in the same camera shows how much less active he is in the new situation.

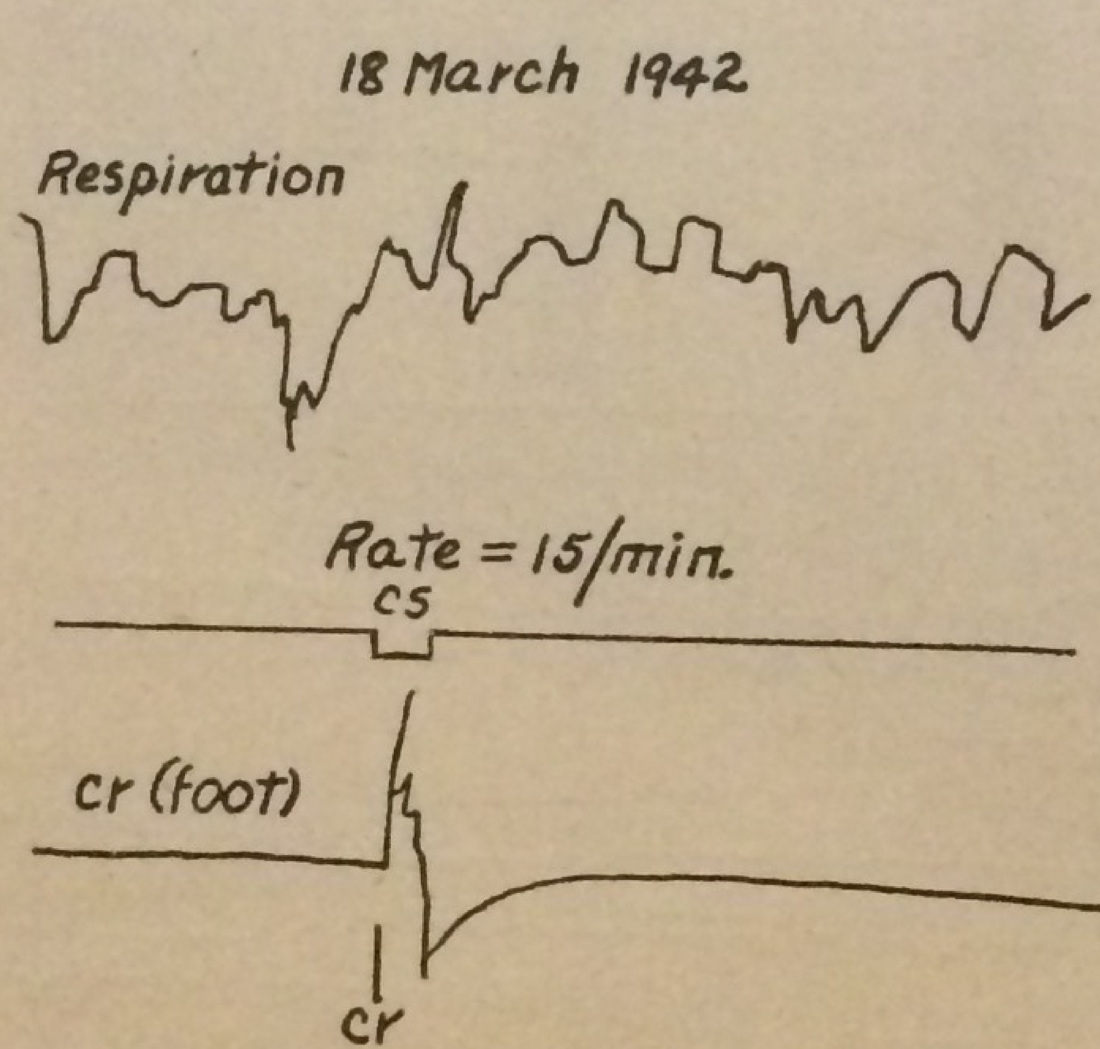


FIG. 50. Quieter respiration in Nick accompanying new cr formation. Cf. with figs. 11, 28, 30.

It is too early to speculate on how permanent this form of therapy will prove to be, but at present the pathologic effect of the old csi (connected originally with the food, later with defense, and then converted into csi for a pain stimulus) seems to have disappeared for the first time since it began in 1932. The change in his behavior is so striking that I feel warranted in mentioning it here in spite of the shortness of the period during which the animal has been subjected to the new experiments, and the question as to whether other factors, e.g., increasing age, may have contributed.

There is a temptation here to make a comparison with the stimulating effect of War. In its initial phases, until disillusionment, extreme fatigue and exhaustion set in, there is an exhilaration throughout society which more than counterbalances the discomforts and privations. This stimulation is not only seen in normal people, but in the lowered suicide rates (in almost all countries, e.g., in Russia [32, 35] and now in this country), and in the decreased number of neuroses in the hospitals.

It is well to recall here that Pavlov's experiments using food and defense csi simultaneously resulted subsequently in a nervous breakdown and that when we used the same conflicting csi (1934) as new csi for another defense UR (injection of acid into the mouth) Nick formed the new cr but did not show any permanent improvement. Although Pavlov's experiments were arranged differently from the present ones with Nick, in view of the fact that evaluation of behavior involves long periods of observation and that the effect may appear months or even years later as we have shown in Nick, extreme caution must be used in reporting brief periods of experimentation. Suffice it to say that Nick has shown with this procedure the greatest improvement in the shortest time of any therapy used with him.

Two other procedures were carried out on Nick. First, several prolonged periods of rest from experimentation were tried. Thus the dog was kept in his paddock without experimentation for about 18 months from 1934-1936, as well as for shorter periods of several months. Not only were these totally without beneficial effect, but during the interim there was an extension of the neurotic behavior to involve new physiological systems—as noted by the pollakiuria and sexual erections.

Note

Although in milder neurotic manifestations and in many of our dogs as well as in Pavlov's, an interruption of experimentation or even a change in the cr procedure is all that is necessary to return the animal to normal, in Nick the neurotic symptoms could be modified by these means not at all. The social factors had both an acute and a chronic effect—there was an immediate influence whenever a person was standing near the dog, and secondly a prolonged effect from the constant and intimate association of the human.

The dissipation of the "anxiety"-like symptoms by the presence of any person standing close to Nick has been referred to in previous sections (social behavior, respiration, cardiac). Although this effect lasted only a few minutes it was very marked and almost always effectual.

The canine social factors that were of benefit have also been referred to in a discussion of the sexual relationships and the social behavior. Acute sexual excitation has a strongly dissipating effect on the "anxiety" but only for a short period. Also the sexual stimulation of putting the dog in the same paddock with a female in estrus had a beneficial influence only for some time longer than the dog was in estrus, but the same dog not in estrus was without effect on Nick's behavior when they were in the camera together and Nick was subjected to the acute stress.

In a previous section (Ch. IV) it was pointed out that the US (which follows the cr) inhibits all the previous specific cr activity and provides the animal with a quiescent period during which it is freed from the stimulation of the same or related csi. Sexual excitation was for Nick, and for many dogs, much stronger than the food excitation. Thus it provides not only a resting period from stimula-

tion by agents specific for itself, but also by pathological agents related to the nervous disturbance. Such a mechanism however, holds good only for short periods, some minutes. (This discussion, dealing here with only an acute mechanism, should not be interpreted as operative in human behavior, except as a very limited physiological mechanism, which neglects consideration of all the social conflicts that may arise directly or indirectly on the basis of sexual excitations.)

Acting upon the suggestion of several psychiatrists who had seen Nick (Kazanin, Murray, Saul and Whitehorn) and my own previous observations of the effect of the presence of a human companion, Nick was transferred to my farm in Virginia for two periods, two months in 1937 and 18 months later (1938 to 1940). Not only did this involve a complete change of environment, except for the months when he saw me, but he also had an opportunity to develop new relationships toward me.

As the change of environment involved new as well as changed personal relationships it is impossible to say from which of these factors most benefit was derived.

The first period on the farm was from 1 August, 1937, to 3 October, 1937. His initial negative attitude toward me on arriving has been mentioned. In a few days he became friendly, barking and jumping up on me when I approached him. During the first days there he would not eat the Spratts ovals (fig. 23), though later on he did; there was at that time pollakiuria as well as a peculiar pattern of defecation with erections and growling and scratching like a cat with all fours—also seen in normal dogs when sexually excited.

On returning the dog to the laboratory on 5 October, he ran and jumped up on the stand in the camera, there was no urination nor whining, nor fawning nor panting. This improvement lasted for two or three weeks, after which he gradually returned to his former state; the respiration became more rapid with whining to the tone backing off from its former location; sexual erections began to recur in the camera. The improvement is evident in the comparison of figs. 10 and 11.

The second period of rest in the country lasted from 26 August, 1939, until 11 January, 1941. The quieting effect of the change was immediately reflected in the cardiac rate, which was 200 in the antecamera the day of his departure from Baltimore and two days later on the farm only 110. But the other symptoms disappeared only by degrees.

While on the farm he gradually became quieter and in time nearly all the symptoms vanished for the most part though they recurred at irregular intervals especially when he was presented with any element of the laboratory environment. His chaotic reaction toward these has already been described, viz., to the Spratts ovals—negativism, urination, and occasionally erection; to my approach—often agitation, sometimes urination, or erection with ejaculation.

During the summer of 1940 I made a definite effort to become friendly with Nick, feeding him, taking him with me on walks and in the automobile. The changed relationships produced a marked effect. Heretofore he could never be brought into the dwelling without extreme agitation accompanied by micturition, panting, whining, etc. But after my close association with him he became a most devoted companion, following me everywhere, even into the river at about age of 10, though he had never learned to swim before. He exhibited toward me more loyalty and affection than pet dogs which I had there at the same time. As a result of this life, when brought into the dwelling he would, in marked contrast to his previous behavior, lie down quietly at my feet for as long as 45 minutes, without agitation, micturition, panting or any sign of the previous disturbed behavior.

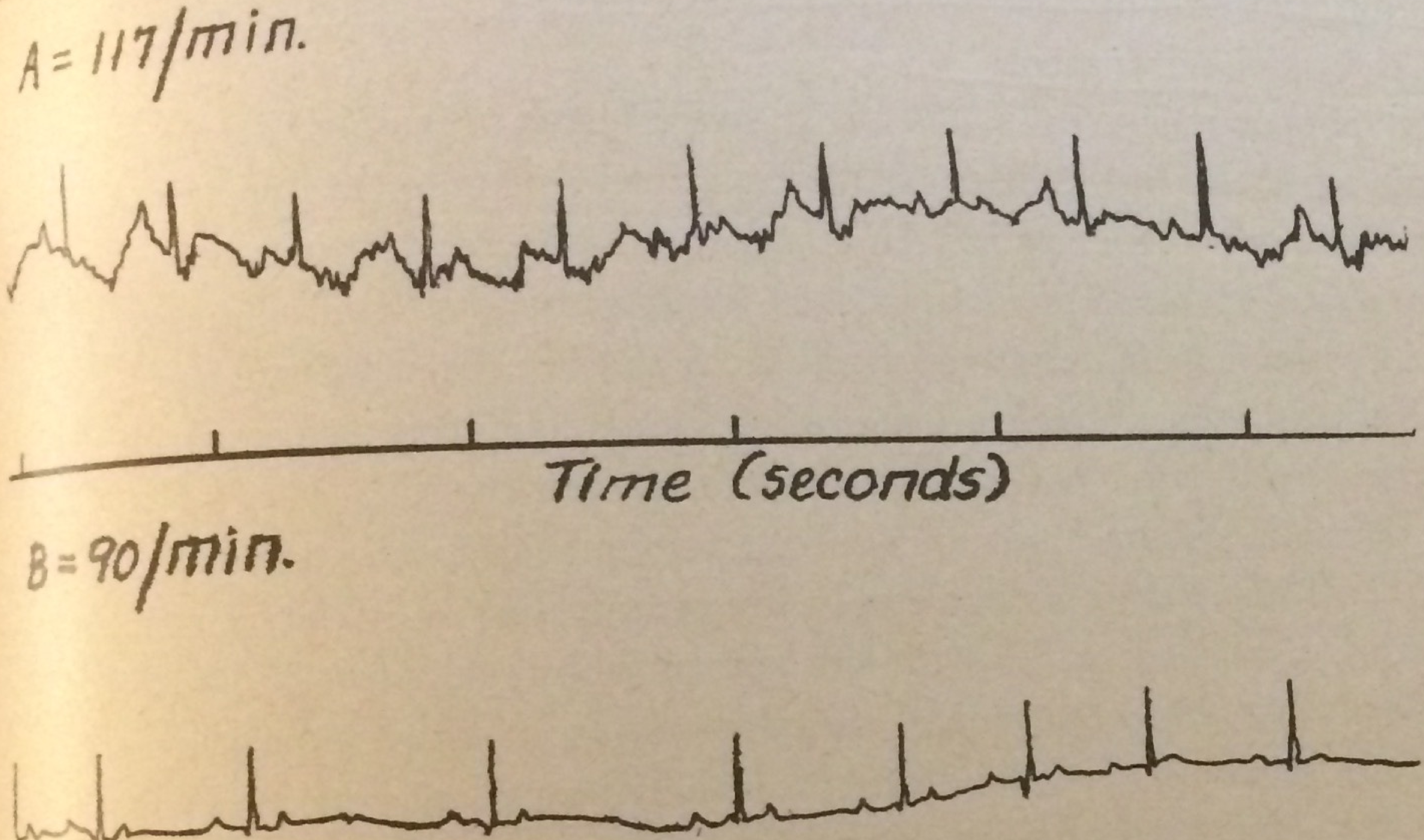


FIG. 51. Comparison heart rates in (A) environment of conflict (27 Feb., '41) and in (B) neutral environment (16 Jan., '41). The top EKG is marked by an irregular wavy line characteristic of somatic tremors and an accelerated rate. "There is no pathologic change in the ventricular complex." (Carol Thomas.)

It was apparent to all those who had known Nick that his behavior was much closer to normal that it had ever been since the beginning of the disturbance in 1932.

When returned to the laboratory in 1941 he remained improved for several months, and is still not quite so disturbed as he was previous to his prolonged rest in the country. The benefit was reflected in his quieter behavior toward me, the diminished agitation, and the fact that the experimental environment had not the previous inhibiting effect on the sexual reflexes. However, sexual erections still appeared when he was taken into the camera. Although his general behavior was not so disturbed as formerly, there were days during which his rapid respiration

and other symptoms showed that he was by no means cured. His improvement can clearly be seen by comparing the respiration on 27 February, 1941 (fig. 25) with that in 1937; the heart rate before being taken to the country, while there, and on his return in 1941; the effect of the camera on the sexual reflexes as shown in fig. 40. That the old environment had an effect on him can be seen by comparing the heart rates in the camera (rate = 117) with a room in the laboratory where Nick had not previously been (rate = 90, fig. 51).

Of all the therapeutic measures employed, the prolonged rest in *another environment plus the social factors* were almost the only ones effective, except for the new procedure of transforming the csi mentioned above. While on the farm he was apparently all but cured. But when brought back to the laboratory life the gradual reappearance of his symptoms indicated that the cure could not survive a return to the old environment.[3]

The pronounced influence of the social factor in maintaining normal life is evident especially in the dog (particularly his relation to the human companion) but also in many other species. In Chapter III several instances were mentioned of how dogs became depressed, or even die after the death of their masters. And even in an animal so far removed from us as the bee the deprivation of the society of its fellows, even though all the other living conditions are maintained, results in the failure to take food and death within a few days.[4]

The social factor is now recognized among the representatives of psychosomatic medicine and others as extremely important. Just as it has been shown that the heart rate of Nick varies with the person who is taking it or standing by him, it has been suggested that one of the elements from which improvement from shock therapy results is the added attention that the patient gets. As Whitehorn points out the percentage of cures of patients receiving shock therapy in State hospitals is approximately equivalent to the percentage cured in a private sanitarium without shock therapy.

[3] Dr. Catherine Stuber and Henrietta Brady have reported a rapid and marked improvement in many schizophrenics transferred from the state Hospital to farmlife.

[4] Maeterlinck, Life of the Bee, N.Y. 1901. "Isolate her [the honey bee], and however abundant the food or favorable the temperature, she will expire in a few days not of hunger or cold but of loneliness. From the crowd, from the city, she derives an invisible aliment that is as necessary to her as honey."

II. INDIVIDUAL VARIATIONS AND REACTION PES IN DOGS[1]

OM THE TIME of Hippocrates there have been recrudescences of the attempt classify people on one or another basis and thus predict either their normal dencies or pathological susceptibilities.

Classification has been on a structural (gross anatomical or histological), bio-emical, or functional basis.

1) Scientists as well as politicians and fortune tellers have sought for a quick ethod of divining not only the future but character from some easily discernible mple external configuration ranging from the folds of the hand (palmistry), umps on the head (phrenology) to type of brain cells (architectonics). Popularly nd politically there is the classification of intellectual and moral "superiority" ased on racial types. Examples of systems evolved by scientists are the body-uild classes of Kretschmer (*66*) (pycknic, asthenic, athletic), to the panels of personality of Draper (*18*), the linear and lateral groups of Stockard (*102*), the habitus index of Pearl (*90*). 2) Sometimes the classification has been referred to the gross or microscopic structure of the nervous system, such as the weight of the brain or the architectonics of Vogt. 3) Then there are the biochemical bases— hormonal, endocrinological, etc. 4) Of the functional groupings there are, the 4 temperaments of Hippocrates and Galen, the vagotonic and sympatheticotonic types of Eppinger and Hess (*23*) and the Pavlovian (*88, 89*) functional cate-gories. Susceptibility to disease and accident has been correlated to the type of personality by Dunbar (*20*). Kempf has offered a system combining the metabolic energies with function (*64*).

On the other hand, the importance of natural environment has been stressed, such as the studies of Darwin on evolution, of Petersen (*92*) on geography and climate, of Gantt (*32, 35*) and Garrison (*49*) on national influences and geo-medicine.

Recently two compendious works have been offered with the purpose of com-bining the study of external configuration and function. One of these is the work of Stockard which has been extended by Liddell's co-workers (Anderson and James, *102*). The other is the comprehensive system of Sheldon (*100, 101*) based

[1] No attempt is made here to review the different systems of constitutional classification. Of the recent treatises the reader is referred to Sheldon's detailed and painstaking work embodied in *The Varieties of Human Physique* (N.Y. 1940) and *The Varieties of Temperament* (N.Y. 1942) for a description of the possibilities of configurational classification; and to the excellent and well balanced review of Barbara Betz, evaluating the various systems of classification (*6*).

upon thorough and detailed measurements. While neither of these offers a final answer to the question of constitution they give a rational basis upon which the facts may be tested.

In a general sense, there is no denying the relation between structure and function. "Just as it is written in the tongue, the stomach, and mouth of the bee that it must make honey so is it written in our eyes, our ears, our nerves, our marrow, in every convolution of our brain, that we must make cerebral substance; nor is there need that we should divine the purpose this substance shall serve" (*78*).

The nature of the executor reaction is of little importance, for the connections are made in the central nervous system, and the effector organ may produce very divergent results, not necessarily because the central connections are dissimilar, but because of the executors. Owing to the varying structures of the external defense organs, what a vast difference there is between the reactions to an enemy of an electric eel, a serpent, and a tiger. Each performs like a puppet pulled by strings depending upon what the string is attached to; according to whether the executor is an electric battery, a sac of venom, or teeth and claws (*31*).

In spite of the value of the theory of constitution plus environment in shifting from an exaggerated emphasis on the details of cellular and microbic pathology (Virchow) to a consideration of the whole personality, there are two serious objections to most types of classification. The first is the selection of a characteristic that has a constantly high correlation with the function in which we are interested. The second is the delimitation of the groups—the *raison d'etre* for a decision as to what constitutes the dividing line between groups.

Some of all these physical measurements may be correlated with functional ability but often the correlation is too small to have significance for any accurate prediction. Even so intimate and seemingly pertinent a correlation as brain weight and intelligence is not always paramount, e.g., Anatole France with his very small brain.

Variations from one individual to the other may be greater within the same breed (of dog) or race than are the differences between the individuals of separate breeds or races.

As regards races and structure:

In the past two decades a number of anthropologists have maintained from numerous measurements of the intracranial capacities of many different races of mankind that the different races probably have about equal average size of brains hence equal potential capacities for intellectual development if given sufficient proper cultural stimulation for a number of generations.

The assumption, common to this group of anthropologists (Ashley-Montague, 1940) is that the characteristic physical differences in such organs as the skin, hair, nose, eyes, teeth, cheek bones, and size of body, are superficial differences which have nothing to do with the

inherent brain capacity for developing intelligence. This assumption neglects the fact that sensitivity of receptors and cortex, and not shape of organs, is indispensable for developing intelligence. Neurologists have recently found that intracranial measurements and phrenological evidence are, after certain basic dimensions are fulfilled, unreliable indicators of the capacity for developing intelligence. Relatively small brains have been found in men of great ability and large brains in men of low intelligence. (Kempf, unpublished MS on Attitude.)

The laying of hard and fast lines between groups often means that the individual must be forced into a Procrustean mold. And what should be done with the intermediates? Or he may fall into one category in one system and into an opposing one by another system.

Any system depends in its final justification on the correlation of the characteristic chosen as the index to particular *functions*. It is eventually the function and not the physical characteristic in which we are interested. If there is a justification for the classification of types, temperaments, or constitutions, a study of the *reactions of individuals under similar circumstances* furnishes a reasonable basis for a rough classification. The search for the most *significant* factors rather than any elements which may (or may not) have a correlation with function should be the goal. As the physical type is used to predict function, is it not better to *measure* function directly where this is possible rather than by the indirect method of correlation of physical structure with function, just as it is more important to be acquainted with psychopathic function than with psychopathic anatomy. Owing to the marvelous biological provision through compensation, neither known anatomical nor biochemical changes (as far as they are discernable by present methods) may be reflected in mental function.

While any information that can be derived from all the intricate anatomical, structural, racial and social groupings should certainly not be neglected, the study of the individual for himself is the most direct approach and involves the most significant items. Perhaps such a carefully compounded structural system as that of Sheldon (*100*) may through its comprehensive and careful description of structural factors give a basis for more exact correlations than were formerly possible. But in spite of what we may learn from structure, it is function rather than structure that ultimately concerns us, and therefore the function of the individual is the final criterion. Adolf Meyer has been one of the chief exponents of the study of the function of the individual (ergasia), laying emphasis on the behavior of the individual in his life experiences. This behavior is an essential element in both the personality and the psychopathology of the individual, and the importance of other systems is only for the light they may throw on this central question.

Functional grouping has the advantage of placing the emphasis upon what is most important in the study of nervous disturbances—and that is how the individual behaves in a given environment and whether his reactions (pathological, as

well as physiological) in a selected environment reveal anything of his susceptibility when confronted by a situation of especial stress or conflict.

Although a study of function may seem less objective and more variable, this is hardly true if the conditions are kept constant; and it is function with which all other group characteristics must be correlated to be significant. The constancy of the measures of function has been referred to (see fig. 4), and throughout this book as well as in everyday experience there is evidence that function may change without discernible abnormalities in structure.

When the difficulty of a satisfactory external classification is so great the question arises: Is it not simpler to place the emphasis on the study and classification of function itself where this is possible?

Before describing my own results, I summarize below the classification of Pavlov, based on function and much closer to the ancient Hippocratic one of temperaments than to the anatomical groupings.

In a study of hundreds of dogs Pavlov noted certain functional types. In 1925 in Paris he described the "inhibitory type," a type in which the negative crs predominate. These were usually timid, cowardly animals who moved cautiously with tucked tail and bent legs. In contrast to this was the lively, excitatory type who was always alert and active, and in whom the positive crs overbalanced the inhibitory. However this lively type when restricted becomes easily inhibited and paradoxically is the first to fall asleep or into pathological states under the experimental restrictions. In 1927 Pavlov (*88*) classified his animals into three chief groups: an excitatory, an inhibitory (extreme groups) and a central, well equilibrated group. He furthermore referred his groups to the classical temperaments of Hippocrates, the extremes representing the choleric and the melancholic, and the normal central group the sanguine and phlegmatic. "The characteristic differences become exaggerated under the influence of various prolonged nervous disturbances which develop as a result of excessively strong stimulation or of unresolvable conflict between the two nervous processes (excitation and inhibition)."

Our investigations of the susceptibility of certain dogs to nervous breakdown has been made insofar as possible from the point of view of the study of the individual for himself rather than as a member of a group. There are certain modifications necessary on account of the difference between dog and man, the most important of which is perhaps the presence of speech function and the correlated symbolization in man. With the human subject it is often possible to evaluate the preliminary conflicts from a subjective account based on language. Thus we may obtain his own inner elaborations and the more intricate reactions to life experiences. With the animal as well as with some patients we are cut off from this avenue of approach and the studies must be wholly independent of all those verbal feelings of what the subject is thinking about, how he relates an episode to us, and

we must concern ourselves with how he *acts*[2]—with measurable items, the evidence of excitation and inhibition (positive and negative conditional responses), as measured in the motor system and the autonomic responses (cardiac, respiratory, sexual), the muscular activity, the ordinary observable behavior—and then compare this behavior with what we see and know in the accessible human being.

This has both its disadvantages and advantages. If we are unable by the method of speech to delve into the dog's past, as well as that of some patients, we are, on the other hand, free of the subjective interpretations which enter more readily into language than into less personal and more definitive records, and we get a record that is comparable from one period to another, or from one individual to another.

One of the most significant and impressive facts that has come out of the material on the study of animals subjected to nervous breakdown is the variation in susceptibility of individuals. A reference to the parallel life summaries of the three dogs Fritz, Peter and Nick illustrate how the result depends even more upon the individual than upon the environment when we consider it from the point of view of life history and not simply the acute effects of the daily routine. Parallel studies have been undertaken with other dogs with the same results, viz., the stable showed only a slight or temporary disturbance, the susceptible a pronounced and even chronic neurosis.

The most important factor in relating personality to instability is the observation of the animal under conditions of imposed stress, as has been fully described in Nick. The importance of the individual can be seen from a comparison of Fritz, Peter and Nick. Figs. 8 and 39, 21 and 22 picture the different attitude of two dogs put through the same procedure.

In order to study the susceptibility of the individual I have made use of two lines of information; first, observation of all the natural viscissitudes in the animal's *life* and environment such as is outlined in the dynamic life chart of Adolf Meyer; second, placing the animal in a position of natural or *artificial stress* or conflict and noting his reaction and susceptibility measured in as many physiological systems as possible. Method

In addition to the balance between positive and negative salivary crs as measured by Pavlov, the study of our dogs has been extended to include a variety of observations taken over a major part of the life of each animal. Among these are the 24 hour activity (a record of the running movements); the character of the autonomic variations (respiratory, cardiac, sexual) and their cr rates; the susceptibility to drugs such as alcohol; the adaptability to a change in routine; the regularity of the cr and UR records; the social, both human and canine, adjustments; the variability in the performance of the animals from day to day as well as under special conditions of stress.

[2] Emphasis upon this point of view has gained ground in psychiatry (see Whitehorn 107).

In the dogs which we have studied two striking facts emerge: first, the *pattern* of breakdown in a given individual remains relatively constant, and second the pathological disturbances are expressed in many systems, e.g., a loss of differentiation in the food crs may be accompanied by chaotic relations in respiration, in the pulse rates, and in the secretions (drop of the food crs to zero), and in the suppression of sexual reflexes. (See Ch. VI.)

The absolute amount of the 24 hour *activity* is of no significance in the stability of the animal. Thus two of our most stable animals, as well as two of the most labile, showed extremes of activity: Billy, who has been mentioned elsewhere in this monograph, having an average activity equal to that of Nick, the extremely agitated and disturbed dog; while another dog, Brenda, had the lowest activity of any measured, lying in one place without moving for several weeks. However, there are other aspects of the activity which seem to have a bearing on a neurotic constitution. The fluctuations in the activity, though of some importance in separating active from quiet dogs, do not necessarily indicate labileness.

The most significant fact is that Nick and other neurotic dogs do not show a positive correlation in their activity with the normal dog. Apparently the activity of the two groups is affected by different factors or the same factors in different degrees.

In a previous chapter the effect of *natural emotional shocks*, such as that which occurred when our dogs escaped from the paddocks, has been described. It was pointed out that both the behavior and the crs (as a result of the shock referred to) showed the greatest changes in the most labile dogs. The fluctuation of the crs in the stable animal Billy compared with an hyperexcitable one (Kompa) and a phlegmatic one (Blue) are seen in fig. 6a.

A year later a parallel contrast was seen in a serious battle which occurred between the stable animal Billy and the labile one, Kompa (see fig. 6b).

It is of interest that the *excitatory crs vary* in their stability in dogs of different natures. Thus in Kompa the excitatory crs were less affected than the inhibitory; in a slight conflict they might even be increased. But in Blue, a dog of the inhibitory type (i.e., predominance of the inhibitory crs under normal conditions) excitation was more labile than inhibition. Compare for example the effect of the same situation on the two types of crs on Kompa and Blue (figs. 6a and b).

Susceptibility to alcohol was seen to be greater in Kompa, Nick and No. 3 (an animal with an organic brain lesion) than in Billy (30).

Also an *adaptation* to a modification in the routine of the experiments was best made by Billy, but poorly accomplished by Kompa and No. 3. Billy formed accurate crs to the sequence of the csi, i.e., the order in which the csi were given, as well as to the individual stimuli, while Kompa and No. 3 made the adaptations to

the order very poorly, though they formed the crs to the specific csi independent of their order.

Many pathological phenomena show more *variation* than do the normal, e.g., Price Jones reports an increased variation in diameter of red blood cells after hemorrhage and in pernicious anemia. The extreme variability of Nick compared with other dogs is similarly suggestive of pathogenicity. Not only in his running activity but in the heart rate, respiration, blood sugar, and sexual reflexes the coefficient of variation is high.

The degree of variability may be a measure of temperament as well as of pathogenicity. Therefore it cannot be assumed that any wide swing necessarily indicates a pathological behavior, but the pronounced variability of Nick in many functions gives a picture of an animal under constant bombardment of extreme fluctuations in every measured function. Even the stereotyped behavior of Nick in the environment of conflict, though stereotyped, is a wide variation from his normal function under other circumstances.

Much important information can be obtained by subjecting the animal to a *situation of stress* and recording the effect on the crs; for the imbalance between the positive and negative crs is the first evidence of the failure of adaptation. The most satisfactory artificial stress is the conflict between excitation and inhibition, such as is provided by the difficult differentiation of the csi. This test, furthermore, carries with it the advantages of a very delicate measure for imbalance, shown by the disturbance in the magnitude and other relations between the artificial positive and negative crs. Moreover the disturbance can be observed and recorded long before there is an objective perceptible change in the ordinary behavior no matter how carefully observed. The imbalance is measured not only in the secretory component but in other accompanying autonomic components of the cr, e.g., respiration and pulse rate. Sometimes the disturbance is only an acute one, lasting for a few minutes or several days. Examples of a beginning breakdown follow; in two similar dogs, Kompa and Peik, the inhibitory effect of a new and poorly differentiated cs such as a light, has been previously pointed out (Ch. IV). Both these dogs, though of the excitatory type, showed a tendency to fall asleep. After the light had been used for several days in Peik, its effect was seen in the mounting inhibition and *retardation* of movement, *cardio-respiratory* disturbances, inhibition of *secretion* and of *abnormal sexual* reflexes. Then there were certain motor phenomena—crouching, muscular inertness, refusal of food. The animal showed unusual drowsiness; the cardio-respiratory crs became disorganized. Thus, though there had been an increase in cardiac and respiratory rates to the csi, the disturbance created by a new cs (light) results in a marked slowing of the heart and of respiration. The effect of the light on Peik is also shown in the cardiac rates—on 10

February the control rate was 90, the cardiac cr to Bu = 108 and the rate to L40 = 66; the respiration was increased with Bu but slowed with L40. (Experiments of Victor Rosen.)

The sexual reflexes were also inhibited for several days while the new cs was being used. This acute effect on the sexual reflexes in Peik was similar to the chronic manifestations in Nick. (See discussion of Sexual Reflexes, Ch. VI, section 6.)

As soon as the disc was removed from Peik's face he accepted food readily even while he was on the stand, and outside the camera he immediately ate voraciously. The removal of the salivary disc abolished the inhibition just as it often did in Nick; the effect is probably comparable to the removal of the hypnotic state by some small change of routine in Pavlov's experiments.

The correlation (negative) between stability and fluctuation was also seen in the UR secretion of dogs to a given amount of food (*34*). All the stable animals gave a constant secretion to a given weight and kind of food but the pathological dogs showed marked deviations.

Another example of the factors of instability not determinable except by the method of putting the animal under stress and then measuring the crs and accompanying reactions can be seen in the following two dogs, brought into the laboratory in 1940. By casual observation of the animals running about freely it was not possible to get a consensus of opinion from eminently trained clinicians (both medical and psychiatric) as to which one would be more susceptible, though it was evident that C was the more quiet. However, when both were confronted with the same laboratory procedure of forming positive and negative motor crs to a faradic shock, C formed them more readily, differentiated quicker and there was less disturbance in his respiration, heat rate, and activity (figs. 26, 37, 52).

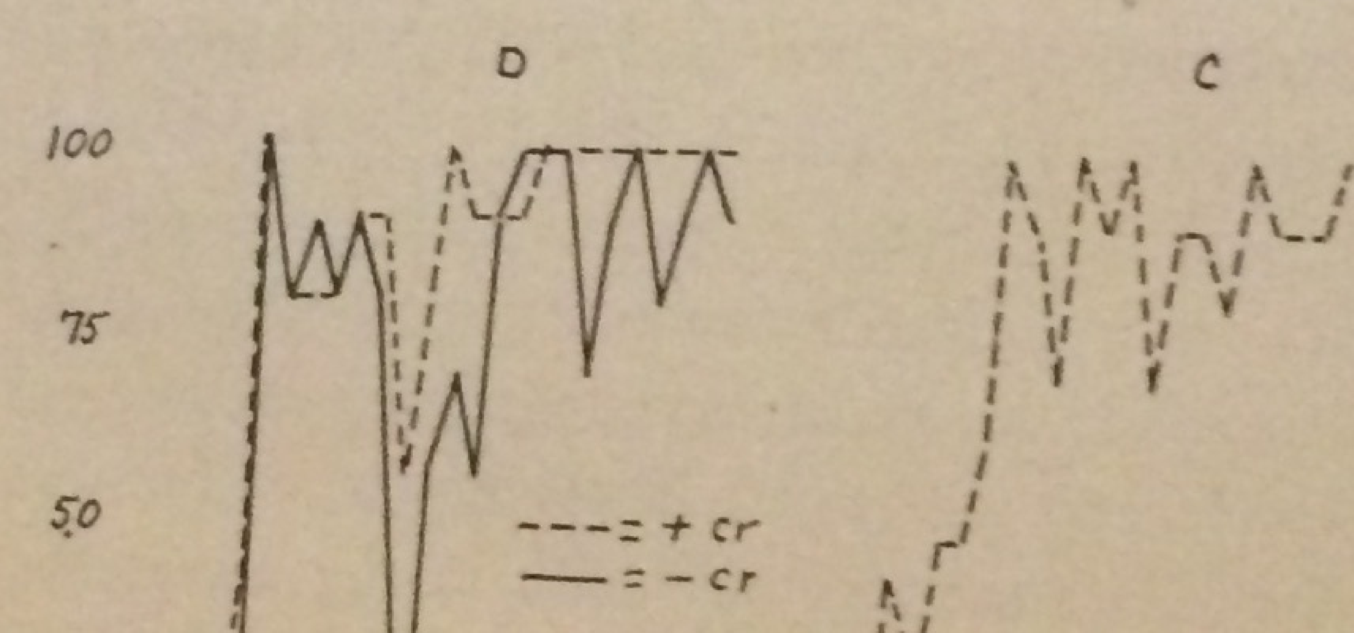


FIG. 52. Formation positive and negative cr in hyperactive labile type dog (D) and in stable dog (C) showing degree of differentiation between M60 (+) and M100 (—). Perfect differentiation: M60 = 100%, M100 = 0%.

The hyperactivity of D compared with the more regular and placid behavior of C has been seen throughout in the cardio-respiratory crs as well as in the 24 hour activity record. Thus at the end of November before the two dogs had

differentiated between two metronomes (M60 and M100) one of which was followed by a faradic shock, the pulse rate was markedly increased in D, but only slightly changed (decreased) in C (Table 29). On December 11 the deviation was less marked in both dogs, and at this time dog C showed a differentiation both in his movements and in the heart rates, but D showed no differentiation.

On January 3, 1941, dog C was differentiating between M80 (+) and M100 (−), successfully avoiding the shock, and the heart rates with the csi were 68 and 69 respectively, compared with 76 control. In dog D the cr heart rates were 113 and 119 respectively, compared with control of 85. However when this dog, by the introduction of a new differentiation, could not avoid the shock, the heart rate became conditioned long before the proper muscular movement, showing an average rate of 150 compared with 113 in the control intervals.

TABLE 29

CONDITIONAL HEART RATES IN STABLE DOG (C) AND IN LABILE DOG (D)

DATE	CONTROL	HEART RATE			
Date	Heart Rate in Interval	with +cr		with −cr	
		During Learning—Gets Shock			
		Rate	% Change	Rate	% Change
Nov. 30, '40	C=72 D=92	C= 55 D=182	−24 +98	C= 57 D=180	−21 +96
Jan. 3, '41 (a)[a]	D=90	D=144	+73	D=155	+72
		After Learning—Avoids Shock			
Jan. 3 (b)	C=76 D=85	C= 68 D=113	−11 +32	C= 69 D=119	− 9 +40

[a] (a) = first part of experiment, with poor differentiation.
(b) = latter part of experiment, with good differentiation.

A comparison of C and D shows that a new differentiation results in marked disorganization of the cardio-respiratory crs in D, but very little disturbance in C. The record of C to all the changes and new differentiations introduced into the experimental set-up, showed consistently greater equilibrium than that of D. Parallel to this C was ordinarily placid and quiet, while D was either hyperreactive, struggling, whining, and trying to escape from the stand or trembling with an attitude of tension with tail tucked.

Whether or not the fluctuations are another measure of the same thing that the abnormal behavior is, the existence of the fluctuations in so many systems in the labile animals and their absence in the stable ones seems more than a coincidence.

Many dogs can be put into one of the four Pavlovian groups of temperament, but the most evident grouping is *stable* and *labile* on the basis of the study of

those functions most closely related to the behavior under consideration.

While the functional study based on psychopathology, noted when the animal is placed under rigidly controlled environmental strain, does not overcome all the objections of classification and is more time-consuming than the short-cut of making one or two physical measurements, it has enabled us to predict the breakdown of the animals more accurately than can be done by other systems.

Even in the first month of experimentation with Nick, a clue could be seen in his susceptibility to stress. Thus as referred to in his history, it was noted that he over-reacted to punishment on the very first day, by refusing to eat the next day, and again two weeks later he became extremely restless and refused food when the systematic elaboration of the first cr was started. In contrast no such behavior occurred in the two dogs, Peter and Fritz, subjected to the same routine.

Several important questions deserve consideration in a final evaluation of the results, in spite of their clearcut character.

First, are we recording chiefly individual patterns of reactivity in certain types or actual susceptibility to the imposed strain?

Second, are we measuring only susceptibility of certain physiological systems in the given individuals or of the whole personality? For example it is known that one person will break down with a gastric ulcer, another with arteriosclerosis, another with hysterical paralysis under stress and conflict. Third, is the conflict (situation of stress) that we introduce concerned with items that might be significant for the human subject or are they too trivial to be correlated with the important life experiences?

A satisfactory answer cannot be given to all these objections until further work has been completed. It is undoubtedly true that our tests do concern susceptibility of certain systems dependent upon the type of individual, giving us evidence not only of the susceptibility to breakdown but the functional type of the individual and the relative susceptibility of the various systems. The question of system susceptibility vs. susceptibility of the whole personality requires careful analysis; it should be met by taking several measures that show a high correlation with the personality rather than by using a single measure (*48*).

The predominating importance of the individual is evident in the behavior of Fritz, Peter, and Nick when the stress was increased. In spite of the terrifying experience of the explosions in the camera close to the dogs tied on the stand, the behavior was not markedly altered nor worsened beyond the point it had reached by the previous difficult differentiation. This is of extreme importance because it indicates that the *labile* may break down permanently and maximally under a light load, while the *stable* may show only a temporary disturbance regardless of the severity of environment. There are animals intermediate between these extremes.

Of more importance than the classification into groups, even with the use of

the most closely correlated characteristics, is the thorough study of the individual. The large number of possible combinations of factors of susceptibility make the study of the individual more revealing than is the statistical summary based on an average of a given characteristic in many individuals correlated with an average of the results of stress in many different individuals. The variations are often more important than the average (Table 19).

With organisms the question is more complex than with inorganic structures but even where iron and steel are concerned, albeit no one can predict when a bridge will fall[4] we are not only in a safer position when we know whether the bridge is made of iron or wood (structure), but still safer if we test the bridge when it is in use and loaded (function).

In reviewing the comparative effects of the various causes of pathological reactions, including all the natural events, physical traumata, and situations of fear mentioned in Chapter III, the following fact stands out boldly: *the stable animal remains stable and the labile animal who cracks under one kind of stress shows the same pattern of abnormality under other stresses.* This is of tremendous importance, because by subjecting the organism to an artificial though significant (i.e., involving sufficiently strong underlying tensions—described under the terms UR, motivation, drive, emotion) strain we may predict its susceptibility as well as the pattern of the pathological responses.

Bo Theory induction

A more detailed account of all these factors applied to the study of the human being is given in my article, "Measures of Susceptibility to Nervous Breakdown" (*48*).

See?

[4] Many bridges constructed under rigidly known circumstances and by competent engineers have fallen under a combination of factors not foreseen or from some property of the structure resulting from its configuration in a certain environment rather than from a consideration of the materials, e.g., the Takoma bridge which began to sway with a certain load and with the wind and crashed.

IX. PSYCHOPATHOLOGICAL MECHANISMS

Physiological, Psychoanalytic, and Sociological Explanations

The material of this monograph has been obtained by the intensive, prolonged and comparative study of a few individuals rather than by subjecting large numbers of animals to a set procedure. By this method we are able to see individual differences. And though we are unable to state what per cent of animals break down or what happens in the total population, we get a clear picture of what may happen to individuals.

A large number of animals is desirable when we want to rule out individual variations. But in a study such as this the individual is one of the important factors, and an average with other animals in a large group would tend to obscure just the thing we wish to observe. It is the detailed and controlled study of each dog separately and not the statistical average that reveals the mechanism of the disturbance; a statistical summary and average in such studies would tend to eliminate just those personality differences that we wish to see, leaving perhaps a zero result. If a given animal manifests the same symptom with clock-like regularity when brought into a certain environment over a period of years, we have facts that are as fundamental and unalterable as, and more significant than, those in a statistical survey covering hundreds of dissimilar individuals.

In defense of the method of intensive study of a few individuals, may be mentioned the importance of such careful continuous observations in an individual as were made by Beaumont on the gastric secretion in Alexis St. Martin, which provided the basis for much of the future work of the physiology of digestion. And most of the observations in this material, albeit from only a few individuals, could be again and again demonstrated (throughout a decade in the life of one dog) when the conditions were reproduced, thus giving ample evidence that they were not chance reactions.

An intensive and comparative study of individuals though made by different observers may enable us to accumulate data leading to a rational classification of types.

Because it has been possible to see in one dog (Nick) the origin and whole development of the various patterns, beginning in the acute stage and passing into chronic, life-long, stereotyped patterns, the discussion below is drawn chiefly from the studies of him. In almost any dog, however, one may see an acute disturbance the extent and duration of which depends upon both the procedure and the susceptibility of the animal.

As described in the historical review of Pavlov's approach to the experimental

neuroses, the "collision" of excitation and inhibition is sufficient to produce at least a temporary disturbance. The variety of procedures which may be employed to bring about such a disturbance have been described in Chapter IV. It behooves us now to ascertain what are the factors involved and what is the underlying mechanism of the disturbance.

Besides the acute disturbances we have to consider those which appeared years later, became chronic, and involved many other physiological systems than the original center of excitation (e.g., food or pain).

Pavlov's concept of the collision of excitatory and inhibitory processes is an hypothetical one with little direct factual evidence.[1] However it finds some support in the discoveries recently of excitatory (acetylcholin) and inhibitory (sympathin) substances by Loewi, Babkin, Wolff, Cannon, Rosenblueth, Rioch et al. An explanation such as this depends upon the actual existence of two simple independent processes as excitation and inhibition postulated by Pavlov. note

But this is still in the terms of physiology, and as important as physiology is, it deals often with infinitesimal units whose interactions may or may not cancel each other before they rise to the surface to produce ripples in the personality. But human psychopathology cannot be expressed adequately in foreign units and terms, unless these can be shown to have a direct relationship to its own phenomena.

Although it is too early to elucidate all the hidden mechanisms operative in the nervous breakdown, even in the experimental animal carefully controlled as regards both the origin and the reproduction of the symptoms, it is helpful to bring together the material in some rational order and to search for the explanations. In order to give a wide base to the approach and a well rounded picture I have asked three psychiatrists representing different schools of thought, all of whom are familiar with the experiments here, to analyze the data in the light of their special conceptual backgrounds. As the authors have kindly given me carefully written accounts I can not do better than quote from them verbatim with some supplementary remarks of my own.

This procedure may seem to be shirking my own responsibility and not living up to a duty that I as well as other scientists recognize, viz., the courage to come to conclusions about one's own experiments (*36*, *89*, p. 30). However throughout this monograph I have given my own explanations of the events and the experiments at the time they were described. For me now to add to my explanation of the mechanisms a complete system of psychopathology would give the false impression that I am ready to build up a whole new system in a field of immense complexities

[1] Such a state of affairs, however, is common in the physical sciences. For example, the structure of all matter, of atoms and molecules, the electronic theory, the wave theory of light are fully as theoretical as are Pavlov's theories of brain dynamics.

in which only an experimental beginning has been made. On the other hand more knowledge may be gained by an attempt to bring these facts in line with existing modern concepts of psychopathology as stated by several disciplined observers.

A. The Pavlovian School of thought is represented by Ischlondsky's explanation by the principles of induction and irradiation. Ischlondsky, the author of one of the best summaries of the whole conditioned reflex literature (*58*) has supplied an explanation of the involvement of other physiological systems in Nick based upon irradiation and induction.[2] In brief, Ischlondsky postulates that the excitation in the affective center, sets up on the principle of induction the opposite process (inhibition) in the food center but by irradiation the excitation spreads to the other centers. The law of induction is operative in the former instance and irradiation in the latter because of the greater intensity of the first excitation.

Thus the urinary and sexual centers become charged with excitation, and the conditional excitations make a functional path to these centers. Pain biologically is closely related to sexual excitation. Examples in nature of the gross functional relationship of pain and sex can be seen in the association of painful stimuli (e.g., the biting, ferociousness, and parallel vocal expressions) of animals during sexual excitation or coitus. Even the word "passion" has not only the meaning of intense suffering but also of sexual feeling. Masochism and sadism may arise on the basis of this close biological association of the emotions of pain and sexual excitation.

Ischlondsky says of the mechanism in Nick compared to the human being:

> A child is submitted to corporal punishment. The mechanical irritation provokes an excitation of the pain center. Under normal conditions the reflex reaction is a negative, defensive one. Likewise would a normal conditioned response be a defensive one, that is the aspect of the instrument of punishment, for instance, would provoke the same negative reaction of the child.
>
> Under favorable conditions, for example if the constitution of the child is particularly susceptible to irradiation of the excitatory process or if the environment is especially conducive (humiliating circumstances under which the punishment is afflicted, presence of other children, etc.), the excitation of the pain center, having reached a certain intensity, may spread over the neighboring brain portions and reach the sexual center, releasing from there a sexual reaction; owing to the intermediary of irradiation, we obtain an inappropriate positive reaction, and since the conditioned stimuli of the environment coincide in time, such circumstances develop an inappropriate conditioned reflex so that the mere aspect of the instrument of punishment will lead henceforth to the same inappropriate reaction. It is evident that my scheme of indirect conditional-reflex connection has one link more than the Pavlovian scheme of direct signalization, the additional link being supplied by the irradiation from the pain centre to the sexual centre.
>
> The same is valid for the process of induction, with the only difference that an excitation

[2] For an explanation of these terms see: Pavlov (*88, 89*).

of the primary centre (B) would lead to an inhibition of the secondary centre (B^1) and therefore provoke an inhibitory reflex, and vice versa.

The conditioned-reflex connection by indirect signalization proved again and again, in my observations on school children, to be responsible for a pathogenesis of masochistic tendencies. An analogous cr determined by irradiation of the excitatory wave from the primary centre, where it had been directed, toward another centre, from which it actually released the response, is presented by the following condition which I had opportunity to observe in a boy. This youngster had an extremely sensitive and labile excitatory process. If, when taking a written test in mathematics, for which a certain time was given (usually an hour), the boy did not succeed in solving the problem in time and had only a few minutes left for formulating the answer before the bell rang and the papers were collected, he used to get into a state of great excitation which most frequently led to a pronounced sexual reaction with orgasm. Apparently here likewise the strong excitation of a certain area rapidly and extensively irradiated and reached the sexual centre from which it released the specific reaction. It is interesting that in this boy conditions of life resembling the environment of the paradoxical reaction had a similar effect leading to characteristic excitation. In other words, here again we have a cr established with the secondary centre, which was the result of irradiation.

In my opinion, an analogous process has taken place in Nick. Here the difficult encounter of the two antagonistic nervous waves during the process of differentiation and the following breakdown have led to the creation of a pathogenic focus (which has found expression in a state of "affect") with enormous excitability of the animal as a result of the victory of the excitatory process in the conflict. This excitation has then irradiated to the sexual centre (as well as to the respiratory, etc.) just as in the above cited human examples, releasing a typical sexual reaction. Nick's peculiar behavior in response to the laboratory environment is, in my interpretation, a typical example of what I call conditioned-reflex connection by indirect signalization (through intermediary of irradiation).

Incidentally, I do not identify the location of the pathogenic focus (the "affect-locus") with the spot where the original conflict during differentiation had taken place. In fact, I presume that this focus is a certain distance from the spot of the cortical differentiation and its formation is in itself a consequence of irradiation.

Furthermore, I consider that induction likewise plays a great part in the morbid manifestations of Nick, just as I observed in the neurotic symptoms of many hysterical patients. This explains the various peculiarities in the behavior of Nick, for instance his attitude in the presence of a strong sexual stimulus or in response to petting. The strong sexual stimulus, for example, provokes by induction an inhibition of the pathogenic "affect-focus" which in turn finds expression in the improvement of the symptoms. The same is valid for petting. In the old terminology we would have said that the improvement of the symptoms is due to "external inhibition" of the pathogenic focus by the new stimulus. Now, of course, we are aware that this is induction.

B. *The interpretation according to psychoanalytical principles.* Alexander, Saul, Kasanin, Murray have pointed out the probability of the personal relationships involved in the production of the experimental neurosis in Nick. It was from these

early suggestions that my experiments on the human factor in Nick's behavior were investigated. As has been described, reciprocal relations were definitely found to be operative, thus the symptoms of anxiety were ameliorated by the presence of a human being, and conversely Nick developed a negativistic attitude with marked respiratory and cardiac changes toward these persons.

French considers Pavlov's positive cr as equivalent to "an affective association", conditioned inhibition as parallel to Freudian repression. External inhibition is equivalent to the repression based upon an extraneous motive (fear), and internal inhibition, equivalent to failure of gratification.

Dr. Leon Saul[3] has very kindly furnished me with the following explanation of Nick's symptoms, in so far as they may be compared with these human relations:

From the clinical psychoanalytic standpoint the behavior of Nick suggests the following interpretation:

There are at least two factors in operation in his neurotic behavior. One is the actual experimental procedure which provides two stimuli to an important reflex function in such a way that the dog is unable to discriminate between the stimuli. This produces a state of indecision. This is also analogous to conflict in human beings. For example, one girl was in a state of aggressive neurotic confusion. Her parents were divorced. When she lived with her mother, the latter exacted extreme puritanism, and then during the other half year she lived with her father who was not only very free in alcoholism, promiscuity, etc., but encouraged the girl to be the same. A much more common clinical variety of this conflict is seen in the second generation son, conditioned by his father to ideals of success, independence, self-made man, etc., but by his mother to being soft, dependent, indulged, spoiled by her. It has always seemed to me that this type of conflict is quite analogous to that seen in animals conditioned to salivate to one stimulus and not to salivate to a closely similar one. However, the level at which this conflict takes place is not clear. It is probably at a rather low level, far from consciousness although higher levels could be secondarily involved. The second factor is the dog's reaction to the entire experimental situation as opposed to the detailed procedure of the experiments. The relations to human beings are one part of the entire experimental situation. That is, the dog is placed in a situation which is very disturbing. He therefore develops a dislike of this situation and a resentment against it. It is common knowledge that dogs have a very high capacity for attachment to their masters and this factor must be taken into account in order to be able to understand a dog's behavior. In this case, it seems clear that the dog becomes defensive and resentful not simply toward the uncomfortable laboratory situation but also against his master who is the experimenter who treats him this way. In other words, the dog becomes conditioned against the entire disagreeable situation. If this treatment of the dog is continued the dog becomes resentful not only against the experimental situation and against his master but against the entire laboratory and perhaps against all the surroundings, and everyone and everything associated with them. In other words, resentment spreads in the well known clinical fashion of the spread of a phobia. (In human cases an individual may

[3] Comments by letter.

be afraid of a certain street and then this fear spreads to include the entire street and then the entire district, perhaps even the entire city and so on.)[4] Perhaps his hostility may spread to include all men, or all human beings. The evidence of the dog's hostility seems quite clear. He is badly behaved toward Dr. Gantt, he emits a foul odor, endeavors to run away from him and to run toward other people. The neurotic, that is abnormal, behavior of the dog can be interpreted as follows:

He has a strong attachment to Dr. Gantt of the normal canine variety. He is dependent upon him, obedient to him and affectionate toward him. But, opposed to this attachment is a resentment owing to Dr. Gantt's treatment of him in the experimental situation and also a wish to escape from Dr. Gantt, and away from the entire threatening and traumatic situation. When Dr. Gantt takes him to the laboratory these opposing tendencies come into sharp conflict. On the one hand is the tendency to be obedient and well behaved with his master. On the other hand he fears and hates the experimental situation and tends to rebel against obediently following Dr. Gantt, probably feels very hostile toward him and wants to escape. If the dog were an undomesticated wild animal he would probably indulge these latter impulses by attacking Dr. Gantt and trying to flee. But because he is domesticated, that is, tends always to be docile and obedient and because he has a positive attachment for Dr. Gantt, he cannot indulge his primitive defensive impulses of fight and flight. These impulses are acutely aroused however and can be thought of as an intense excitation of instinctual origin. Because the dog must remain well behaved this excitation cannot be adequately discharged in direct and primitive action. It is pent up and seeks discharge in other directions. This is apparent in the diffused excitement of the animal consisting of restless movements, urination, erection and other signs of vegetative and somatic activity. All of these activities can be interpreted as substitute outlets for the excitation which cannot be discharged along primitive patterns of fight and flight. That sexuality can drain excitement of all kinds is a well known clinical observation in humans. Many individuals who find themselves in frustrating situations obtain relief by masturbating and also by sexual relations. Urination is also exactly analogous to what can be observed in human beings. Many persons, perhaps women more than men, when they become excited become slightly incontinent of urine, sometimes violent laughter is enough to result in this. Even closer to the experimental situation of the dog is the analytic situation. It is a very common observation that patients who have considerable anxiety about their analyses and who force themselves to come in spite of feelings and wishes to stay away or flee show marked frequency of urination. They say frankly that they do not want to come to the hour, feel nervous and urinate several times before the hour, immediately afterwards and sometimes must even leave the hour to relieve themselves. This situation is almost identical with that of the dog, coming against his will to the experimental situation. I am sure that other psychosomatic and behavior symptoms manifested by the dog could be closely paralleled by clinical observations.

The general behavior of the dog toward the experimental situation and toward Dr. Gantt might be characterized as a type of anxiety with phobias, certainly the latter. He wishes to

[4] For an example see—Fenichel—Outline of Clinical Psychoanalysis, New York, Norton, 1934: pp. 160-161.

shun everything associated with this disagreeable experience. A connection with the traumatic neuroses is apparent.

As to actual content of some of the dog's behavior, one point is very suggestive. The dog is seen to run up and down the steps, back and forth. Such behavior finds a certain analogy in the clinical condition of compulsion neuroses which is characterized by opposing tendencies which may either create doubt or else may be acted out in succession, first one and then the opposite. (Freud, The Rat-man [29], the patient of Freud who removed a stone from the road and then put it back.) Although these remarks are less certain than the above, it is at least suggestive to relate this behavior of the dog to the content of the traumatic situation. That is, the dog's uncertainty in behavior, repeatedly reversing himself, may be a manifestation of a condition produced by the experimental situation which was also one of doubt: the dog being placed in a situation in which behavior in one direction or another could not be definitely affected by the stimuli.

These reactions of Nick are most fascinating from the analytic point of view. The drop in heart rate (in the country) is of course exactly what one sees with human beings when they are removed from a situation which stimulates their anxieties or hostilities. In analyses, during periods in which the patients' resentments are mobilized, one very often finds increases in heart rate, as well as frequently extrasystoles. As to Nick's reaction to the food, that is a typical example of "soiling aggressions." The use of urine and feces aggressively was pointed out by Freud and is seen in varying degrees in the dreams and fantasies of almost every analytic case. Relationships with bowel disturbances such as functional colitis and constipation have been dealt with by various authors, most completely by Alexander and his associates in the Gastro-Intestinal Symposium of this Institute. Dr. Margaret Gerard has touched upon the aggressive significance of urination in her review of enuresis. Certain patients when they become angry dream of soiling with urine or feces. Indeed a careful search through the dreams of our gastro-intestinal cases would probably reveal a few very similar to Nick's actual behavior. This aggressive use of the excreta is clearly reflected in popular obscenity and is seen in the practices which have been reported from Germany and also during the last war in which troops would defecate on the floor of occupied houses and would hold prisoners in the latrines and sometimes directly urinate and defecate on them. The connection between anal activity and sadism was first pointed out by Freud and the study of these relationships has been the main work of Ernest Jones. There is considerable evidence that all children go through a stage in which anal and sadistic impulses are important in their psychological organization. The erection fits into the picture perfectly.

I would reconstruct the situation about as follows: The appearance of the food, through its associations with the painful and traumatic situation of the experiment, arouses in Nick a reaction of rage. This rage is in the nature of a defense reaction against having anything to do with the painful situation. The physiological tension of the rage is relieved through the soiling which has a hostile, aggressive meaning, and the same excitement also produces the erection. It is a well established clinical fact that any emotion that is strong enough causes some sexual sensations, or manifestations, as though the sexuality were one method of relieving physiological tensions. A business man, frustrated or excited in some deal, may go out with a prostitute or masturbate. With the sexuality there is probably a direct physiological

relationship.[5] I have heard that if food is taken away from a monkey, he may react with anger and then by going off and masturbating.[6] This relationship has been expressed analytically by saying that the emotion gets "eroticized" or "sexualized." I have a patient who gets sexually aroused when he gambles, and finds this more exciting than actual sexual relations with a woman. This leads to the very interesting question as to whether the expression of rage by urination and defecation is a natural biological reaction in the dog or whether this is a result of his training in cleanliness, that is, of the cultural factors. It is generally considered that children do not use the excreta obscenely or aggressively until after they have been trained to cleanliness and learn to consider them dirty and disgusting and thereby discover that they can use them as a means of defiance, depreciation, etc. If Nick had never been house-broken, he might not have used the excreta in this way. On the other hand it may be that through his ambivalence, his affection for Dr. Gantt was strong enough to inhibit any overt manifestation of aggressiveness, such as direct attack, and therefore the hostility was expressed through the visceral activities of urination and defecation and also sexuality (according to one of the current theories of the psychogenesis of organ neuroses, as discharge via the autonomic nervous system of nervous excitement not discharged through the normal paths of overt activity). A third possibility is that the eliminative function, particularly the defection, was involved because the stimulus was food. This would mean that the behavior had an eliminative as well as an aggressive meaning. This receives some support from the fact that Nick took the cracker into his mouth and then dropped it and then eliminated on it. This spitting out is seen in hysterical nausea and vomiting on a similar basis and the eliminating meaning in diarrhea is clearly discussed in the Gastro-Intestinal Symposium. His heart rate might be some index as to the importance of the role of the hostility which I should guess was the main reaction, particularly since the urination and erection were also observed. In summary then, I would see it about as follows: He is offered the food; this reminds him of the painful situation (i.e., not only of the personal relationship which operates more as a force to cause repression), he therefore spits it out. Possibly his impulses to eliminate are so strongly aroused by this that he also defecates and urinates. However, the defecation and urination are clearly not results simply of diffuse excitement, since they are directed at the food, the offending reminder. Using clinical experience, this would mean that rage was aroused by the food and this was expressed against it by excreting. Moreover, the emotion was intense enough also to stimulate sexual excitement. So far as the eliminative impulse is concerned, this might be a primitive one, independent of any training, but the soiling of the food suggests that the training in cleanliness plays a role in the choice of just this form of aggression, just as babies who are ordinarily well trained will sometimes soil themselves if they are made angry.

Dr. Saul as a representative of the psychoanalysts has emphasized in the above account the powerful influence of the social factors. These have been frequently referred to in the history of Nick: with him, as I have demonstrated, the same human being has both a temporary inhibiting effect on the anxiety and paradoxi-

[5] This is expressed by Ischlondsky as the law of induction and irradiation.
[6] See Klüver's and Jacobsen's experiments referred to previously in this monograph.

cally the ability of eliciting the disturbed behavior; moreover the prolonged friendly association of the experimenter with Nick on the farm "cured" him in that particular environment. There are other striking analogies between the above clinical symptoms and those of the neurotic dogs and many of the explanations which Saul offers seem to fit the material of Nick.

But the fact that the disturbances occur in an isolated experimental environment and at first apparently independent of the experimenter, in spite of any connection that he may later acquire, as well as the fact that such neurotic behavior is seen in a variety of animals as shown by Liddell working with the goat, pig, sheep, Finch and Jacobsen with the apes, Bard and Rioch, Masserman, Karn and Dworkin with cats, Maier, Cook and others with rats indicates that the disturbance of behavior can occur in animals in whom there is no reason to believe that a personal relationship to the human plays a role. Furthermore the fact that in the dogs it is not only related to the total environment but also more specifically and pointedly to the induced conditioned stimuli indicates that besides the personal relationship which evidently is a factor in our dogs, there may be at the same time a more mechanistic basic physiological principle involved as outlined by Ischlondsky.

Here we may recall that Pavlov (*88*) noted and experimented with the social factor in dogs made neurotic by the Leningrad flood, but he did not show the ramifications brought out with Nick, nor did he place as much emphasis upon it as the psychoanalysts do.

Although Saul[7] recognizes that "biological reactions, e.g., rage, are important whether generated by personal or impersonal situations," frequently the overemphasis of the Freudian explanations by others leaves one with the impression that the personal relationship is everything—a view as unsubstantiated as the strictly mechanistic one of the reflexologist.

The explanations of Ischlondsky and of Saul provide striking analyses of the mechanism of the sexual manifestations in Nick. It is possible that each may represent a different aspect of the same mechanism; e.g., the quality of heat may be expressed by the physicist as a motion of molecules, by the engineer as the ability to move a piston and by the physiologist as an effect upon sensory nerve endings. A cow is a collection of chemical compounds, an animal that gives milk, and an object having a certain financial value. None of these aspects are exclusive and each is useful in a different way. Clearly our point of view must be determined by pragmatic considerations, viz., the significance of the concept for the field in which we are working. If this field is therapy the use of those principles of proven therapeutic value is required; but research must make room for revision of concepts leading to new methods.

[7] "Basic conceptions of psychoanalysis are grounded on the understanding of biological development and functioning, an important part of which, but only part is the emotional relationships with other persons." (Leon Saul, personal communication.)

But whether or not the above explanations would suffice for a general explanation of all nervous disturbances is a question subject to the following considerations. The widespread connections of the sexual function, its intensity and predominant influence are facts which cannot be doubted. But in most dogs, as well as patients, sexual symptoms are not nearly so marked as in Nick or may perhaps be absent. The three patients of Whitehorn, Rosen and Barker, mentioned in Chapter VI are exceptional instances rather than ordinary ones. I do not deny, however, the possibility of a much more widespread latent sexual excitation which may exert an influence without a direct expression in the sexual system. Some psychiatrists, e.g., Kanner, Conn (*13*), in contrast to the psychoanalysts even fail to find any significance in the sexual erections of young children, while others would trace this relationship back to an antenatal condition (Greenacre [*51*]).

Since Nick's symptoms are so similar clinically to anxiety, it is interesting to inquire into how closely the origin of his symptoms fits in with the Freudian explanation of anxiety. These have been clearly stated by Greenacre. The origin can be definitely traced back to a known and artificially produced conflict, but it is difficult to see how the birth trauma in Nick could be a prototype. It would seem more plausible that such marked sexual phenomena in nervous disturbances occur particularly in a certain type having a susceptibility of the sexual function, just as peptic ulcer is seen in a nervous type with a special susceptibility of the gastrointestinal system. According to this view any autonomic function might be involved, depending upon the individual susceptibility, and though the sexual function would, on account of its intensity and predominance often be the basis of most of the symptoms it would not necessarily be the origin of the conflict. Thus the sexual system might be on a par with other autonomic functions—a collateral rather than the original center of the disturbance. Naturally the sexual as well as other symptoms would, in proportion to their intensity, be widely connected with other functions and subjective feelings. This concept is in keeping with the views which are loosely expressed by the current term "psychosomatic." While such a concept gives to the sexual function a predominating influence according to its evident intensity, it does not make the sexual function the necessary center of origin, thus leaving room for other disturbances to develop, to use a physical analogy, in a *parallel circuit rather than in series* with the sexual excitation.

C. *The socio-anthropological explanation.* Another concept of the contrasting factors in man and animals is that of Alexander Leighton, a pupil of Adolf Meyer's, and a serious student of anthropology. Leighton's summary is derived from a broad sociological point of view.

As the common ground for man and animals:

> A tendency to stay alive is characteristic of all forms of life and in most creatures is a dominant urge that underlies much of their relationship to their environment. It may take

two general forms: (1) predatoriness, in which objects are overcome and made to serve the animal's needs or, if potentially dangerous, destroyed; (2) avoidance, in which objects are ignored or, if potentially dangerous, fled from. For many animals the world is a place composed of positive and negative objects, which he examines and deals with by either predatory or avoiding methods. The issues are essentially clearcut. As an animal you exploit the world for food and shelter and you stay alive by overcoming those organisms you can and by running away from those that you cannot, and it is not usually difficult to tell which is which.

Co-dependence Leighton emphasizes is a main difference between man and animals:

Man differs from most other animals in being utterly dependent on his fellows for his basic biological needs. He cannot stay alive apart from his own kind. This does not mean that individual human beings have never succeeded in living alone, but it does mean that the human race, in the numbers it has today, in a world with the size and resources of this one, could not survive two months without close cooperation. Man is as dependent as any horse or cow, and would fare just as badly if turned loose alone in the jungle. Where other animals maintain life in an environment made up of all sorts of things, man finds that the most important part of his environment is essentially one element, namely his own kind.

Out of this social dependence comes both our strength and weakness, and as Maeterlinck (77) says, in the long run it may be our undoing:

Our adversaries have always been isolated, unconscious; and for these thousands of years the one enemy that really counted has been ourselves.

Leighton continues:

The urge to live is as strong in man as in any other animal but, due to this social dependence, it is dynamically more directed at social factors than at clearcut issues of obtaining food[8] and avoiding attack. Therefore people are more shaken by disruption of personal ties than by financial disaster. It is not to be inferred from this that a person must think each time he shakes hands or buys a suit of clothes that is in fashion or carries out some other social act, "I am doing this to preserve myself," any more than he has such thoughts each time he eats a sandwich or stands on the curb until the traffic goes by. Nevertheless, social relations and activities have these biological significances related to security and survival. In terms of natural selection, one may say that people who were unable to develop traits that make for social adjustment died early or were killed off by their fellows.

As I have pointed out, the dog has adopted many human qualities. Many instances have been given in this monograph of the social relationships between the neurotic dog and his master, comparable to interhuman relationships.

[8] This is clearly brought out in cr experiments using the food reflex in human adults—the food reflex is so subordinated and easily inhibited that it is difficult to evoke by the ordinary means used with animals. (W.H.G.)

Can the general social environment be treated with the simple predatory and avoidance methods used by the lower animals? To some extent it can. One can preserve his sense of security by being predatory, by being so powerful and terrible that all others are afraid of him; or he can preserve his sense of security by submission and the avoidance of conflict. However, between the individual and his social environment there is a third possibility, reciprocity. Reciprocity represents a matured form of the relationship that exists between a child and his parents: "If I love and obey you, you will love and protect me." Between adults this becomes, "If I help you, you will help me." The Christian Golden Rule is a high ethical expression of this.

The basis of the conflict in the human being is described as involving different ends from those used in the laboratory as the basis for the experimental neurosis in the dog. Our experiments indicate that social factors have an influence also in the dog but to what extent and whether universally so cannot be determined. The psychoanalyst would place much more emphasis on this relationship than has hitherto been done by those working with experimental neurosis. How much of a factor this is in the animal is a question for future research.

Since predatoriness, submission and reciprocity are the three principal methods of achieving adjustment and survival in a social environment, there will be some people who will practice one method most of the time, while the majority of people will practice all three methods some of the time. The natural outcome of this is confusion and uneasiness on the part of the individual. In his social environent he is utterly dependent on his fellow man, but much of the time he doesn't know how or where to place his dependence. He knows that a burglar is predatory, and he knows perhaps that his children will submit to him and he knows that certain friends are square with him, but by and large he knows that people are likely to be opportunists and can very well seem to be one thing while they actually are another. Are his business associates reciprocal or are they trying to steal his customers? Are his customers going to pay him? Who is predatory, who can be trusted? What of the neighbors? What of the politicians, through whom the welfare of the nation is sought? What of the police force that is supposed to protect? Are all these reciprocating with him when he pays his taxes, or are they treating him in a predatory fashion and using what they can get out of him for their own ends? Are his friends likely to take advantage of his leisure moods to put over deals or beat him to niches of social position? He can be sure that there is great striving, but what to expect from whom and when is often unclear. Life is a game that requires him to make shrewd moves against opponents and with friends, many of whom are not playing according to the same rules.

So far, I have spoken of a man as if he were the victim of social Brownian movement, but the confusion and blurring of outlines is no less when he is considered as a more active element. If he is reciprocal at the wrong times he will be swindled. If he is predatory at the right time he will reap the prestige of power and position, but if he does it at the wrong time he will become a social outcast. Worse than this puzzlement, he may actually hold several different roles in the structure of his society that put conflicting demands upon him. As a business man predatory activity may be forced on him as a necessity in order to gain subsistence; in social life it may be required of him that he be strictly fair and reciprocal; at home, in order to hold together his other securities, he may have to be submissive. In actual

living these things cannot be kept separate. What is he to do when a friend comes to him for business purposes at a time when his own family needs money and the only way he can get it is to treat the friend with predatory methods? In close and intimate human relationships, this uncertainty is no less. The most trustworthy partner in a reciprocal relationship in one set of circumstances may at the very same time be predatory in another set.

I have, up to this point, considered social relations only from the biological foundation of survival. If now, we consider them from the equally biological foundation of sexual trend, it will be at once apparent that the opportunities for confusion are vastly increased. Even when the individual knows perfectly well what he should do for his own best social survival, he is often tempted into relationships which snarl up all his other dependencies.

In short, man is exposed to the greatest complexities at the points where his urge to live is most dependent—his social relationships. Culture is the establishment of patterns of behavior that are commonly shared and which therefore bring some clarity to the issues. In well established societies most of the hopeless confusion which I have described above may not exist at all. However, in periods of rapid change and in the mixing of many cultures together, confusion tends to predominate over the patterns, and the patterns which do exist are often flatly contradictory. For example, a large number of Americans believe simultaneously that: (1) Every one should try to be successful, (2) The kind of person you are is more important than how successful you are; (1) Honesty is the best policy, (2) Business is business, and a business man would be a fool if he did not cover his hand; (1) America is a land of unlimited opportunity and people get pretty much what is coming to them here in this country, (2) Of course, not everybody can be boss and factories cannot give jobs if there are not jobs to give; (1) Education is a fine thing, (2) It is the practical men who get things done; (1) Paternalism and public service are fine things, (2) Of course a man has to look out for himself.

Leighton thinks that the pattern of the conflict in man is probably related to that of the experimental neurosis:

The experimental "neurosis" in animals shows that when an animal is confronted with two conditioned stimuli that it has great difficulty distinguishing, the animal tends to break down. It seems reasonable to suppose that human beings are "conditioned" to various social stimuli and, as a consequence of the confusion and blurring in the social environment just described, have the constant strain of making difficult discriminations. Human neuroses may in part be reactions to such situations, and thus have a relationship to the experimental "neuroses" in dogs. The idea might be formulated thus: Any given break is the product of the constitutional tendency to that reaction and experience with chronic difficulty in discriminating points of social orientation that call for different action.

The parallel between a functional constitution in the dog and in man is evident:

It is possible that some people will object to considering the urge to live as fundamental in the dynamics of human behavior, since it is often seen that men hold life to be cheap in the face of other values. What of the soldier who gets himself shot in the performance of duty? In many instances such actions can be seen clearly as the result of the person valuing the esteem of his fellows and therefore his security in society above the risk to life. He takes

chance and hopes to come out of it with profit, like Steve Brody, who jumped off the Brooklyn Bridge and gained fame and fortune. The need for security in society has come to overshadow the more primitive urge to immediate safety. However, there are instances in which this sort of conception will not work. The martyr, who will allow himself to be burned at the stake rather than recant is an example. He goes to certain death and knows it.

There is undoubtedly a basis in the life of all animals for anxiety, viz., the real imminence of insecurity. Nearly all animals including man in his wars are hunted and attacked by others. Then there is the insecurity based upon nutrition, etc.; it is only in the last century that the human being has found it within his means to free himself of this latter form of insecurity.

The mechanism of conditioning to distant stimuli and of what Pavlov would refer to as chain conditional reflexes is brought in at this point to show how this early conditioning may drive the human being to his death.

Perhaps the concept of conditioning will help explain this. At some time in his life the martyr invested his total sense of security in a set of beliefs and values. The unconditioned stimulus was the need for affective satisfaction relative to security. The conditioned stimuli were the content of his creed and the ritual. There was no extinction in the course of the repetitive performance of these conditioned stimuli, because the affective needs were always fulfilled in the martyr. Therefore when he is at last faced with the necessity of giving up his entire security system or making the final gesture of investing all in it, he dies at the end of his long experience of religious conditioning with his eyes on security beyond the grave.

In a less extreme form this sort of thing is seen every day. People form attitudes and traits in the course of growth and development, and later run into situations in which these are inappropriate. Rather than give up the attitudes in which they have invested their sense of security and which give them emotional satisfaction they will run counter to all the requirements of more adequate adjustment to the immediate social circumstances.

Rosenzweig and others have stressed the widespread character of what is generally considered under the term of frustration (98). Jacobsen's production of temper outburst and whimpering in chimps after making errors in distinguishing under which cup food was placed can be referred either to frustration or differentiation that is too difficult (59).

Note

This would seem to involve the principle of excitation without gratification. As has been described in Chapter IV, when the US follows in proper sequence the conditional excitation, all the cr activity is arrested and there is a refractory period during which the animal is not subject to stimulation by any other stimuli having to do with the same basic excitation. However if the US for any reason whatever does not come in its proper place, or if there is too long a delay between the cs and the US, the animal becomes restless and the cr activity is prolonged and accompanied by a generalized spreading of the excitation to involve extensive muscular activity and chaotic relations in the autonomic system such as increased and irregular respiration and cardiac rates.

Such a state of affairs may eventually lead to a non-specific spreading of the excitation or it may develop into a chronic inhibition which may remain localized or become widespread. There is much evidence accumulated in this laboratory that inhibition is an active process, really a negative excitation (*110*). Both the respiratory and cardiac rates attest that inhibition is an active process (*46*). This has also been shown in Pavlov's laboratory by the phenomenon of disinhibition, where the inhibitory process becomes excitatory, transferred into the specific excitation upon which it was based.

If inhibition is considered then as an active though blocked excitation in the nervous system not extending to the efferent and executor organs involved in the original positive excitation, such as the grasping and eating of food—it is either still present as a potential excitation, or on the other hand it may remain blocked as regards its own specific excitation but overflowing into new physiological systems. Such an extension may be considered to occur on the basis of Pavlov's principle of induction, or more simply as a local damming with generalized overflow of the excitation.

Note

Induction would explain the general excitation as a direct result of the specific inhibition in the center concerned (food, defense), but induction as met with in the experiments is a transient phenomenon lasting only a few minutes or seconds, and therefore the concept must be extended and so modified that it applies to the more complex and chronic manifestations as well as to the artificial crs. Although the two processes of induction and irradiation do give us a hint of the laws governing a simple type of spread of excitation and inhibition, substantiation of the same mechanism in such complex chronic phenomena has not been carried far enough in the laboratory to be of more than theoretical interest here. It must be considered as a descriptive term for a phenomenon clearly demonstrated for simple crs but only an hypothesis for prolonged effects, and even then not entirely explanatory. It deserves ranking with other hypotheses for verification. Even though induction operates similarly to the way it does in the laboratory, the law of induction itself explains little, as we do not know when or why it operates, in spite of Pavlov's having demonstrated its frequent occurrence. The question of why induction seems to be active in Nick (e.g., inhibition of food center in Nick causes excitation of the sexual center) and not in Fritz goes back to the much more important fact of "constitution" referred to in the previous chapter. Until more light is thrown on these individual variations we are still in the dark.

Re theory

Guthrie's theory of a failure to extinguish pathological reactions because the subject avoids the csi which might lead to extinction cannot hold in the animal experimentation because Nick and the other dogs were constantly subjected to the procedure which would produce extinction of the crs.

From the comparative study of a wide range of animals, from the rat to the

higher apes and man one may conclude that the production of a disturbance of behavior is not peculiar to the human being. Many of the objective symptoms in all these animals have a close resemblance—to mention a few, the pollakiuria, sexual erections, and motility disturbances. Not only in the dog and rat as shown by Pavlov (*88*), Löwenbach and Gantt (*76*), Maier (*79*), does one see cataleptic phenomena, but even in such lower animals as the spread-head moccasin. This snake, an inhabitant of the Eastern U.S.A., attempts to discourage attack by ferocious hissing, wide opening of the mouth, and expansion of the neck through inflation with air. Failing in this, the serpent turns upon its back, becomes rigid and feigns death. It remains motionless unless its relation to gravity is changed by righting the animal, or lifting it by the tail, when it again flips over. Such a cataleptic state is maintained in the face of a danger which threatens or destroys life. I have seen such snakes continue in this cataleptic state even though they are brought in contact with the heat of fire, allowing themselves to be burned; or when faced with the predicament of being devoured by a hog, preserving their rigidity while the hog is in the process of picking them up and chewing them.

?

Note

Another notorious example is the opossum who will permit himself to be bitten or killed by dogs—the enemies he is avoiding—before coming out of the immobile posture he has assumed for protection.

Even invertebrates may pass into cataleptic states, e.g., frogs, crayfish, the spider and the stick-insect. That such a state is due to the higher parts of the brain can be demonstrated in the stick-insect by removing the head ganglion, after which the catalepsy does not appear (*106*). The resemblance of this condition throughout the animal range to catalepsy in catatonic patients is striking.

These remarkable instances are mentioned here as evidence of the widespread similarity of psychopathologic processes in all animals in spite of individual and generic variations.

Pavlov has described cataleptic conditions in dogs as a result of conflicts of excitation and inhibition in which the animal becomes as rigid as a statue, particularly in those muscles which were involved in the former excitation, the muscles of mastication and of the jaws and neck and to a lesser extent the forelegs and trunk and hardly at all of the hindleg. The motor system is chiefly involved and the secretory conditional reflexes may remain unaffected—the dog may drool at the mouth at the sight of food but remain rigid in front of it.

Notwithstanding the fact that a pathological disturbance of behavior is a common attribute of a variety of neurotics, undoubtedly generic as well as individual differences exist, both as to the etiology, origin and symptomatology. One of the chief differences between man and other animals is based upon the development of speech and symbolization. In this system arises the possibility of innumerable connections and elaborations. Thus in addition to the accumulation of conditional

signals during the life of the individual are the vastly more numerous word signals and their connections and interassociations. Pavlov has postulated that people fall into two general groups, artists (those with eidetic imagery) and thinkers, the former reacting to the direct conditional signals and the latter to the signals of the signals, viz., speech representations; the symptoms of hysteria result from a weakness of the second signalling system (*31*) (*89*).

Conclusions

The new objective approach to the study of nervous imbalance cannot yet, owing to the fragmentary nature of the work as well as to the enormous complexity of the phenomena, give a complete explanation to the problems of nervous breakdown. But certain definite principles emerge, as pointed out throughout this monograph, which apply to a variety of animals including man with certain modifications according to each species. Because of the objectivity of the method we have a basis for observation and experiment, the possibility of comparing the results of various workers, and the hope of greater progress than that which comes from pure speculation.

The foregoing instances of catalepsy and of psychopathology in general (like the phenomenon of peptic ulcer or of sea-sickness or the pain of renal colic) are examples of the lack of perfect adaptations, of the perversion of "meanings," and of the persistance of a mechanistic physiological principle which though it may have originated on the basis of configuration to structure and environment, has become detrimental rather than helpful to the individual. Granted that the hyperacidity of peptic ulcer or the state of arterial hypertension can be related to agression, one is still at a loss to explain, for example, as pointed out by Bard (*91*), the "meaning" of the pain in renal colic or the loss of equilibrium and nausea in sea-sickness. Certain it is that the pain has a meaning for the patient but it serves no useful purpose and it originates only on the basis of a badly integrated mechanism. It is less anthropomorphic and more in line with objectivity to consider that our isolated physiological mechanisms exist in structure and "constitution" (as ill defined as this term is) acting blindly; for we must admit that the laws of nature are blind to our logic and feelings. On the basis of known physiological function inherent in structure and evoked by environment (internal and external) the phenomena are comprehensible but on the basis of origin from an integrated "meaning" they are meaningless. Symptoms like hysterical paralysis may arise on the basis of symbolism, others originating from function inherent in structure and environment. Nevertheless the feeling that they give rise to after they have occurred is assimilated by the individual and used symbolically, and in this way they may assume an integrated meaning for him (*post hoc ergo propter hoc*).

Such a view does not deny the interaction of physiology and psychology, of crs

and URs, nor the potency of suggestion and symbolism, but these do not necessarily proceed according to the pattern of our conscious and well reasoned "meanings," and if the word is intended in a strictly biological sense a less confused, less ambiguous, and less anthropomorphic one is desirable.

There has been a tendency to cling to "meanings" and symbolism too exclusively as sole explanations of behaviour—reminiscent of the place assigned to teleology by our ancestors. Such fallacy was strikingly demonstrated by Francesco Sizzi, Florentine astronomer, who justified himself in denying Gallileo's discovery of Jupiter's moons by the statement:

"The satellites are invisible to the naked eye, and therefore can have no influence on the earth, and therefore would be useless, and therefore do not exist."

Living organisms *tend* toward integration of their activities and of their adaptations, as has been emphasized by a host of philosopher-scientists, from Aristotle through Darwin, Smuts, Jennings. In this sense they differ from the automaton of Descartes. Furthermore this integration usually has some purpose, directed toward an end, for the organism. But there are also involved in the various functions "blind" mechanics, which though ordinarily integrated for the purpose of the total organism, may under certain circumstances assume an independence not harmonized with the best purposes of the organism. The energies of the individual are often mis-directed—neither for efficiency nor pleasurable ends nor for preservation of life nor for the offspring nor for ultimate good—but because of imperfect adaptations the living unit or a part may react in such a way as to defeat all these goals. The resulting chaos may end either in mass disorganization, such as is represented by war, or in individual disorganization leading to the neuroses and psychoses. Our aim should then be not to insist upon the inexorable functioning of a universal principle but to find out by observation and experimentation *under what conditions* the various principles work.

An additional concept to these two principles of organization and mechanics may be added to give a more complete picture: Apparent chaotic symptoms and expressions such as those of the psychotic, being the result of a special attitude, may serve a certain function for the organism, in relieving tensions. From this point of view it might be unwise to try to remove symptoms without attention to the basic attitude (Whitehorn, *91*).

Attitude is as important a determinant of the response as is the stimulus; the reaction of an animal to the same stimulus may depend entirely upon whether he is hungry or angry, and this in turn upon the setting. For example, a honey bee in the hive will aggressively attack you, but in the field she will take pains to avoid you. Touch a dog while playing and wagging his tail or again on the identical skin spot while he is fighting; the same stimulus will at one time make him lick your hand, at another time bite it. Or stand with an ear of corn in your hand before a

hungry bull seeking food and again with the same food before the same animal enraged and pawing the ground!

The internal state of the animal is equally as important as the external stimulus whether cs or US. This has been pointed out with the food cr (both salivary and cardiac components, fig. 37). Also Sears found that sexually starved roosters mounted hens whom they had formerly avoided "as if with loathing." D. M. Levy reported that nearly all adolescent children sent to him for stealing sweets were on a diet deprived of sugar, an observation in line with Richter's rats seeking what is deficient in their blood.

It is important to recognize that the laws of psychopathology are not always the same as the laws of normal behavior. The spontaneous development of the system "neuroses" in Nick and their persistence is evidence that the pathological conditions arise according to laws differing from the physiological, probably by some mechanism of internal conditioning similar to what I have described as "intraneural" conditioning (*9, 33*).

Intraneural conditioning is based upon the introduction of stimuli within the central nervous system instead of from the outside. Although such stimuli were introduced artificially it is reasonable to suppose that the spontaneous fluctuations of excitation and of thresholds in the nervous system based upon internal rhythms of secretion (*95*) and other unknown factors may act either as stimuli or determinants of attitude. Such factors (determining the state of the organism) complicate the picture and introduce an element of unpredictability. Whether or not spontaneity as described by Adolf Meyer, free will, etc., is identical with the fluctuating state of the organism cannot be solved by any laboratory experiments so far performed.

In contradistinction to the normal conditional reflexes, the pathological reactions persisted for years without apparent reinforcement. However a certain type of reinforcement may occur on the basis of internal emotional states which in turn may be initiated or elaborated on the traces of past stimulations. The echo of the emotional states on the cortex, through various afferent stimulations, proprioceptive, etc., conceivably may act as reinforcement for the trace stimulations in the cortex ("memory") which the emotions aroused, as has been proposed by Ischlondsky. This being so, we have a closed system within the organism of automatic effectual reinforcement not subject to ordinary extinction. There is overwhelming evidence that the emotional states do persist, but whether they occur in the same relationship and on the same pattern (cs—cr—US—UR) is entirely hypothetical. But the work of Light and Gantt (*73*) and others show that the external aspect of the UR is not necessary in this chain for conditioning. The conclusion from these experiments of eliminating the effector organ and those of Loucks (*74, 75*), Gantt and Brogden (*8, 9*) in elimination of the afferent limb of the reflex arc

show that the conditioning procedure depends essentially upon the central structures.

That the light stimulus after only a few associations with the tone in the pathologic animal (Nick) rapidly acquires the ability to produce the same state in the animal as the tone does, although the light itself was at first neutral and had had no relationship to the original conflict, indicates that the pathological condition occurs more readily and becomes more quickly stable than normal conditioning. Evidently the underlying emotional state is of enormous intensity to furnish the ground for so much more rapid conditioning than occurs with the normal conditioning of either food reflexes or defense reflexes to pain. Furthermore we see from the ease with which the light becomes a conditional stimulus for the emotional defense responses that pathological secondary chain crs can be elaborated more readily than can normal chain crs. From this and numerous other experiments it appears that any stimulus occurring in the same immediate milieu with the pathological state can later elicit this state. Thus a sharp whistle by one of the experimenters (H.L.) after being repeated several times also elicited exactly the same stereotyped anxiety-like pattern of behavior.

The great potency of the pathologic state as a basis for forming crs has been seen with Nick where only a few repetitions of the L (with one of the original csi which had become excitants of the conflict) was enough to form the L into a pathologic cs. On the other hand, many more repetitions are necessary to form ordinary stable food or defense crs.[9]

Beside the ease with which psychopathological crs are formed, the prolonged persistence without external reinforcement and their stability and intensity are other marked pathological characteristics. The entire history of Nick bears out these statements; nevertheless I shall cite here two examples in the autonomic system. As regards the heart rate, it was repeatedly shown that the heart rate was nearer normal in the presence of real danger such as an attacking cat or bulldog than it was in the situation of conflict. The second instance is evident in the comparison of the sexual reflexes as a component of the total response in the situation of conflict with the sexual crs formed in the ordinary laboratory method. The sexual cr formed in the normal routine manner was very weak and often absent, while the sexual erection occurring as a component of the response in the situation of conflict was pronounced and persisted for years without reinforcement. See for example the predominance of this psychopathological form of sexual cr over the normal sexual cr in the note under date of June 8, 1939, in Chapter V.

[9] Trigant Burrow's (*10*) work suggests that there is an element of psychopathology in ordinary human behavior, and that perhaps the same principles underlie psychology as psychopathology. The differences brought out in our work may be largely in the nature of increased intensity of the underlying emotion in the formation of psychopathological reactions. This is a field for further exploration.

It is certain from all the foregoing experiments that we must consider the personal relationships and the interlocking of functions as well as the more specific mechanisms that recur in a stereotyped fashion. And in spite of the canine variations we see much in Nick that is basic for the human being.

Though it is as true now in psychopathology as it was in the world of Epictetus 2,000 years ago that we cannot "pretend to alter the nature of things, it is neither wise nor desirable to make the attempt, but accepting things as they are, let us strive to accord our minds with them"—yet, just as we have manipulated to our use discoveries in the other realms of science, precise knowledge of the laws governing human behavior may help us to re-arrange our world to avoid the disasters that result from the combination of a certain individual or groups of individuals with a certain environment.

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